Lake Erie Fisheries Assessment Unit
Report 1988-2

ESTIMATED INCIDENTAL CATCHES OF SMALLMOUTH BASS IN COMMERCIAL GILL NETS, LONG POINT BAY, LAKE ERIE, 1987.

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EXECUTIVE SUMMARY

1. Incidental catches of smallmouth bass in commercial gill nets were investigated for the late April-October period of 1987 in Long Point Bay. The following two methods were used:

   (a) examination of incidental smallmouth bass catches during simulated commercial fishing in the vicinity of the Fishing Reserve Boundary, and

   (b) on-board observations of 55 actual commercial fishing catches

2. The total catches of smallmouth bass in commercial gill nets were estimated by first identifying the critical period of vulnerability by bass to commercial gill nets. The actual catches then were derived by expanding the catches of bass per unit of gillnet effort (bass/km of net) to the total effort reported by commercial fishermen on Daily Catch Reports for the critical period.

3. The critical period of vulnerability for waters in the vicinity of the Fishing Reserve Boundary (Areas 1 and 2, Figure 3) was determined, by simulated fishing, to be between July 1 and September 30. The total incidental catch of bass was estimated to be 3,823 ± 1702 bass for Areas 1 and 2 in 1987, and 7,490 ± 2,880 bass for Area 3. Thus, the entire catch in Long Point Bay was estimated to be 11,414 ± 3,678 bass.

4. Because reported commercial gillnet effort in 1987 was atypically low in 1987 (down by 70% in Areas 1 and 2, and down by 56% overall in comparison with 1985 or 1986) we also estimated what

incidental catches would have been under effort levels prevailing in 1985 and 1986. For the entire bay, estimated catches were as follows using past effort levels as the expansion factor:

a) 1986 EFFORT: 26,507 ± 5,429 bass

b) 1985 EFFORT: 26,533 ± 5,667 bass

5. Observations on-board commercial vessels and during simulated fishing suggest that some bass may survive if released and returned to the water immediately. Estimates of potential survival from entanglement are crude, but suggest that under current fishing practices 25% may survive. If commercial fishermen were to remove and release all live bass immediately, then approximately 52% may survive. Thus, our estimated catches do not necessarily equate to complete kills.

6. Under current fishing practices, estimates of actual bass kills for the entire bay were as follows using the 1987 and 1986 reported commercial effort:

1987 EFFORT: 8,561 bass
1986 EFFORT: 19,880 bass

Some 97% of the bass killed by gill nets were age 2 or age 3.

7. Population sizes of the age 2 and older bass population were estimated under various mortality regimes, and estimated kills then were placed in the context of the entire population size. Under current fishing practices it was estimated that some 8% of the age 2 and 3 year old segment of the population are killed by commercial gill nets (using the 1986 effort levels).

8. The bass population was mathematically reconstructed with gillnet mortality reduced to zero. The most representative of predictions would appear to be that the catchable (by anglers) segment of the population ($\geq$4 years old) could be increased by 7 to 21% if the incidental kill were to be eliminated.

9. Anglers currently harvest an estimated 55,030 bass annually from Long Point Bay, and angler success rates have been improving in recent years. The angler harvest removes some 37% of the catchable segment of the population annually.

10. In terms of annual yield and success rates, Long Point Bay continues to support the best smallmouth bass sport fishery in the province. While information concerning the status of the population is limited, there is no biological indication that the estimated incidental kills jeopardize this fishery. Removal of the incidental kills may improve what is already the best bass fishery in the province by an unknown, but limited margin.

11. Incidental catches of bass/km of gill net are some 30% higher in Area 3 (Figure 3) than in waters near the Fishing Reserve Boundary (Areas 1 and 2). Further work concerning incidental catches in Area 3 is required to verify the estimated catch in 1987, and to identify areas and periods of vulnerability in these waters. In addition, further study is required to examine the contributions of bass in Area 3 to the sport fishery.

12. Existing information suggests that incidental kills of smallmouth bass in Long Point Bay can be substantially reduced with some modifications to current commercial fishing practices. The

following options were presented for consideration:

a) restrict gill netting in Areas 1 and 2 to deeper waters (at least during the critical period),

b) obtain further estimates of incidental catches in Area 3 where we have no previous information,

c) define the critical period and area(s) of vulnerability by bass to gill nets in Area 3 (there are reasons to expect that this period will be substantially different in these waters than in Areas 1 and 2),

d) based on (c) consider restricting gill netting in waters of Area 3 to defined areas, at least during the critical period, and

e) emphasize to commercial fishermen the benefits of releasing live bass carefully back to the water whenever possible.

13. The following additional studies are recommended to increase our knowledge of incidental catches and their effects on the bass population:

a) Since 1987 was the first year in which we were able to estimate catches for the entire bay, it is recommended that one additional year of sampling be carried out to confirm the estimates. This survey should consist of On-Board sampling and should encompass the entire bay.

b) Simulated fishing should be carried out in Area 3 for at least one year to define the critical period of vulnerability in these waters and locate "hot spots" within the area where bass catches are highest.

c) Tagging studies of smallmouth bass, which focus on describing the seasonal distribution and movement of bass within the bay are required to answer questions relating to the importance of bass in Area 3 to the sport fishery.

d) Further work designed to more carefully ascertain potential survival of bass from entaglement would be beneficial in estimating kills.

1.0 INTRODUCTION

In 1983 and 1984, the Ontario Ministry of Natural Resources carried out some preliminary work in Long Point Bay concerning incidental catches of smallmouth bass (Micropterus dolomieu) in commercial gill net (MacGregor 1987). These studies provided preliminary estimates of smallmouth bass catches in commercial gill nets situated near the Fishing Reserve Boundary (Figure 1). However, the estimates encompassed only a 6 week period of time (late July through August) when bass were thought to be most vulnerable to gill nets.

The estimated catch for this period was 7,053 bass, but confidence limits were wide and several information gaps were identified. In particular, as the entire period of vulnerability had not been ascertained, the total annual catch could not be determined. The following recommendations were made to improve the reliability of the estimates, and our understanding of the issue:

(a) further and more intense on-board observations of actual commercial fish catches,

(b) examinations of incidental catches through all seasons in which commercial fishermen operate,

(c) surveys to determine the distribution of commercial effort within the grid locations of interest,

(d) examinations of trends in incidental catches as nets are set further from the Fishing Reserve Boundary, and

(e) attempts to estimate the size of the smallmouth bass population, particularly in the Inner Bay.

In 1987, further work was undertaken to begin addressing the above recommendations. The objectives of the 1987 study were:

(a) to provide a first estimate of the total, annual catch of smallmouth bass in commercial gill net,

(b) to identify the critical areas and periods where bass are most vulnerable to commercial gear, and

(c) to evaluate the effect of the incidental catch on the smallmouth bass population, and on the sport fishery.

This report summarizes the findings of the work carried out in 1987 between April 25 and October 30.

2.0 METHODS

2.1 GENERAL METHODOLOGY

Two main approaches were taken in collecting information concerning the incidental catch. The first approach essentially repeated the simulated commercial fishing exercises carried out in 1983 and 1984 using OMNR vessels, gear and staff. However, the program was expanded (a) to encompass the time period over which most commercial fishing takes place along the Fishing Reserve Boundary (ie. late-April through October), and (b) to include two additional lines running parallel to the Fishing Reserve Boundary, but further offshore. The first of the additional lines ran 1 km further offshore from the Fishing Reserve Boundary, and the second 2 km further offshore (Figure 2). The second approach consisted of a series of on-board observations of actual commercial gill net catches between May 6 and September 30, 1987.

2.2 SIMULATED COMMERCIAL FISHING

As in 1983 and 1984 (MacGregor 1987), simulated commercial fishing was carried out along the Fishing Reserve Boundary (and extension) (Line A of Figure 2), and along the two additional lines running parallel to this boundary (Lines B and C, Figure 2). Potential sampling sites were established by plotting points at 1 km intervals along the three lines.

Eight sites were selected for each of 27 weeks (beginning April 25 and ending October 29, 1987); four of these sites were sampled on one day of a given week, the remaining 4 being sampled on a second day of the week. For navigational convenience, the total sampling area was divided in two areas (Areas 1 and 2, Figure 2). Normally, one day's fishing occurred in Area 1 and the second day's fishing in Area 2. On each sampling day, two of the 4 selected sites were on the Fishing Reserve Boundary (Line A), the remaining two occurred on Lines B and C directly parallel to one of the two sites selected on Line A. The lat-long coordinates of each sampling site were taken from a 1:50,000 nautical chart of Long Point Bay; these coordinates were located in the field by means of a LORAN-C navigational aid (KING model 8001). One strap of gill net, consisting of 2 1/4" square mesh monofilament throughout, was set at each sampling site from the our 42-ft vessel, the RONNIE D. Each strap was 1 km in length and 15 meshes deep. At all times, nets were set parallel to the Fishing Reserve Boundary, and nets were lifted the following day, weather permitting. The sampling schedule is summarized in Table 1.

All fish harvested at each sampling site were sorted according to species, counted, and weighed in bulk to the nearest 0.1 kg (Chattillon Hanging Autopsy Scale Model 815H) on board. Smallmouth bass were taken to the laboratory in Port Dover where fork and total lengths (mm), weights (nearest 0.1 g) and sex were determined. Scale samples were taken from the left side of each bass near the tip of the pectoral fin when depressed and aged at the Port Dover station, using January 1 as the birth date.

2.3 ESTIMATED SURVIVAL FROM ENTANGLEMENT

The potential for smallmouth bass to survive accidental entanglement was again investigated during simulated fishing as follows:

(i) Smallmouth bass entangled in each strap of gill net were removed either (a) at the puller, or (b) after the nets were overhauled and picked. The numbers of live and dead (no visible movement) bass were counted and the data summarized according to the two treatments.

(ii) Live smallmouth bass (usually no more than the first 10) removed from the nets were placed in live tanks aboard our vessel.One tank contained bass removed at the puller, the other contained bass removed after the nets were overhauled and picked. The number of live and dead bass were counted in the tanks at the end of the holding period (which varied according to on-lake time, but averaged 257 minutes). Data were summarized according to the two treatments.

2.4 ON-BOARD OBSERVATIONS

Between May 6 and September 30, 1987, OMNR staff accompanied commercial fishermen during 55 separate fishing occasions on Long Point Bay. In the beginning (May - June), an attempt was made to accompany only those fishermen who were gill netting near the Fishing Reserve Boundary (Areas 1 and 2, Figure 3). However, because the behaviour of the fishing fleet changed in 1987, and few boats remained in these waters after May, a decision was made to accompany fishermen regardless of where their nets were set in Long Point Bay. Thus, considerable data was collected from waters in Area 3 shown in Figure 3. At this time a strong effort was made to accompany each vessel once per week. Arrangements were made one day in advance of lifting the nets, after the fisherman had set his nets and returned to port for the day. This effort was largely successful and only two fishermen declined to cooperate, until the end of September. At that

time, the remainder of the fishing fleet declined further cooperation. The sampling schedule for this survey is outlined in Tables 2 and 3.

On those days when OMNR staff accompanied a fisherman, the following data was recorded:

(a) the coordinates at the ends of each strap using the fisherman's LORAN-C,

(b) the number of bass caught in each strap, and of these, the number that were alive or dead after removal from the net,

(c) the number of other game fish caught in each strap,

(d) the length of net in each strap (reported by the fisherman),

(e) whether the bass were removed at the puller or after nets were overhauled, and

(f) the weight of yellow perch harvested for the entire day (ie. summed over all straps); this was obtained from the fisherman's visual estimate and by subsequent verification on the appropriate Daily Catch Report (DCR) turned into the OMNR.

Normally, all gill nets used by the fishermen we accompanied were set on bottom to target on yellow perch; occasionally, however, some fishermen set additional canned nets to target on species other than yellow perch. For the purposes of this study, we excluded all data derived from straps that were canned, or that contained twine larger than 3" square mesh. In general, an attempt was made to return all smallmouth bass to the laboratory in Port Dover for detailed processing, but when catches were high (ie. greater than 100), the sample size was reduced.

The usual procedure in determining the amount of effort (ie. length of net) represented by each strap was first to ask the fisherman and record that information. This information was subsequently verified

(a) by checking the information reported on the appropriate DCR, and (b) by plotting each strap of net on a 1:50,000 nautical chart using the LORAN-C coordinates obtained at the ends of each strap; actual lengths were then calculated by scaling (plotted effort). When large discrepancies occurred, we accepted the "plotted effort" as the best approximation to the actual effort used.

2.5 DATA ANALYSIS

Data summaries were perfomed on an IBM-AT micro computer using SAS statistical packages (Anonymous 1982). Catches per unit of gillnet effort (CUE) were calculated as the number or weight (kg) of a given species per kilometer of net.

As in past studies (MacGregor 1987), the total incidental catch of smallmouth bass in commercial gill net was estimated by expanding the catches of bass per unit of effort (catch/km) calculated in our on-board survey, to the total effort reported by all fishermen over the period, and within the areas of concern. All figures relating to total effort expended by the commercial gillnet fishery (the expansion factor) in a given area or season were derived from computer summaries of the DCR (Daily Catch Report) data base for Lake Erie.

Estimates of total annual bass catches by the commercial fishery were derived by first identifying the period of vulnerability using data from our simulated commercial fishing. Next, the catch of bass/km of commercial gill net (CUE) was calculated for this period within the area(s) in question. Finally, these CUE's were then expanded to the

total effort figure derived from the DCR data base for the area(s) and period in question. Separate estimates were made for Areas 1 and 2 combined (the original study area identifed in the earlier report, MacGregor 1987) and for Area 3 (waters outside Areas 1 & 2, Figure 3). In addition, a final estimate was made for the entire area of Long Point Bay exposed to commercial gillnet fishing (Areas 1, 2 & 3 combined).

3.0 RESULTS

3.1 SIMULATED COMMERCIAL FISHING

In the 52 nights of simulated commercial fishing (representing 176 individual sets) the catches from 173.888 km of gill net were examined. The total catch consisted of 92,503 fish (9127 kg) representing 27 species. Some 23,658 yellow perch (2590 kg) and 1305 smallmouth bass (219 kg) were captured during this period (Appendix Table I). White perch (Morone americana) was the most abundant species in the catch, and represented 51.7% of the catch by number, or 42.7% by weight. Yellow perch (the target species) was the next most abundant species, representing 25.6% of the catch by number, or 29.8% by weight. Smallmouth bass represented 1.4% of the total catch by number (2.4% by weight); but represented 5.5% of the total catch of the target species by number (or 8.0% by weight).

Despite the fact that we began fishing on April 25, we set 49.4 km of net before the first bass was captured on June 18. Subsequently, catches of bass increased rapidly; bass continued to be captured thereafter until October 8, when catches declined suddenly to zero, and remained there (Figure 4).

Over the entire survey area and period (April-October), smallmouth bass catches averaged 7.5 fish/km of gill net (pooling data from lines A, B and C); and averaged 10 bass/km during the July - September period. However, bass CUE's declined with distance from shore,

catches averaged 13.5 fish/km along the Fishing Reserve Boundary (Line A of Figure 2), 8.8 fish/km along Line B and 8.4 fish/km along Line C (Figure 5). Yellow perch catches did not decline with distance from Line A, rather they remained constant, or actually increased (Figure 5). Catches of smallmouth bass averaged 15.2 fish/km over the area (Line A) and period (July 20-August 30) comparable to that used in the earlier studies (MacGregor 1987). Some 97.1% of the bass were age 2 or 3 (51.4% age 2, 45.7% age 3).

Catches of smallmouth bass varied considerably over time and among locations (Figures 4, 6). In general, CUE's were highest between the beginning of July and end of September; within this period, highest catches typically occurred in Area 1 with local "hot spots" in the vicinity of Turkey Point, and in reef areas along Area 1 (Figures 4,6)

3.2 ESTIMATED SURVIVAL FROM ENTANGLEMENT

During 21 occasions when the numbers of live and dead bass were counted at the puller, an average of 77% of the bass were alive. On the other hand, during 23 occasions when the numbers of live entangled bass were not counted until after the nets were on board, overhauled and picked, only 63.2% remained alive (Table 4).

Some 67% of the bass removed at the puller and placed in the live tank were still alive at the end of the holding period. Of those live bass removed after the nets were overhauled, only 42.3% remained alive at the end of the holding period.

As these tests were not derived from controlled scientific experiments, the results must be interpreted with caution.

3.3 ON-BOARD OBSERVATONS

OMNR staff accompanied commercial perch fishermen on 55 separate fishing trips, 20 of these trips occurred exclusively in the original study area (Areas 1 and 2), while 32 trips occurred exclusively in Area 3. All straps of net examined were plotted according to the LORAN-C coordinates collected in the field and are shown in Appendix Figures I-IX. Three (3) trips occurred both in Areas 1-2 and in Area 3 on the same day, but we were able to split the catch-effort data from these trips into the appropriate Areas. No on-board observations were made in Area 3 prior to July because it was not until July that the decision was made to accompany all fishermen regardless of where they were fishing.

In total, we inspected the catches from 201.669 km of gill net (90.801 km in Areas 1 or 2; 110.868 km in Area 3). Some 60,569 yellow perch (6603 kg) were harvested by these fishermen, and 1604 smallmouth bass (221 kg) were captured incidentally in their nets (Tables 2, 3). Most (1100) bass were caught in Area 3 where the July-September CUE averaged 9.9 fish/km; fewer bass (503) were captured in Areas 1 and 2 where the July-September CUE averaged 7.0 bass/km (Figure 7). Only one bass was observed in commercial nets prior to July; however, we did not accompany any commercial boats in June, and no boats in Area 3 were sampled prior to July. Pooling data from all areas over the July-September period, regression analysis revealed that CUE's of bass declined with depth of set. The relationship was weak but highly significant in the form of:

$$CUE = -0.683\ (DEPTH) + 14.2 \qquad r = -0.31,\ P < 0.0006$$

While this relationship is weak, it is instructive to consider the predicted results from this regression (Figure 8).

3.4 ESTIMATED CATCHES

Results of simulated commercial fishing revealed that smallmouth bass were most vulnerable to commercial gill nets from July 1 through September in Areas 1 and 2; catches apparently are negligible in these waters both before and after this period (Figure 5). Therefore, in estimating total incidental kills, it was assumed that catches of bass were zero (0) before July 1 and after September 30 (ie. it was assumed that the total, annual catch of bass in commercial nets would occur during the critical period of July 1 - September 30). It was also assumed that this trend was identical in Area 3, even though no data were collected from these waters before July 1 or after September 30 (this merits further study in future years as there are reasons to believe that the period of vulnerability may be considerably different here).

Analyses of total reported commercial effort over the past three years (1985 - 1987) on the Daily Catch reports revealed a distinct change in fishing effort in 1987. Total gillnet effort (km of net) was atypically low in 1987 when compared to the previous two years (Figure 9). Reported effort in 1987 was down by 57% over all areas, and down by some 70% in Areas 1 and 2 (the original study area). For this reason, estimated incidental catches of bass were made not only for the effort levels reported in 1987, but also for the more typical

effort levels that prevailed in 1985 and 1986. In so doing, the CUE's for bass observed during the 1987 on-board survey were used; this predicts the number of bass that would have been captured in 1987 had the more typical effort levels of 1986 or 1985 prevailed during our survey year.

Using the ratio estimates of Snedecor and Cochrane (1980), expansions of smallmouth bass CUE's to the total reported effort (km of gill net) resulted in the following estimated catches (and 95% confidence limits) for the July - September periods:

Areas 1 and 2

EFFORT YEAR	CUE	EFFORT (KM)	ESTIMATED CATCH
1987	7.0	549.3	3823±1702
1986	*	1755.0	12215±8577
1985	*	1734.0	12069±8085

Area 3

CUE	EFFORT (KM)	ESTIMATED CATCH
9.8	755.0	7490±2880
*	1274.0	12638±3538
*	1296.0	12856±5429

Areas Combined

EFFORT YEAR	CUE	EFFORT (KM)	ESTIMATED CATCH
1987	8.8	1304.3	11414±3678
1986	*	3029.0	26507±5429
1985	*	3030.0	26533±5667

* 1987 CUE's used

Appendix Table II provides sample calculations to indicate how the estimates were derived.

3.5 ESTIMATED KILLS DUE TO ENTANGLEMENT

The estimated catches in Section 3.4 do not necessarily represent complete kills because some bass may survive if released. The survival rate appears to depend on how the bass are handled prior to release (see Section 3.3) The following three mortality rates due to entanglement were considered to derive estimates of gillnet kills:

(A) 100% Mortality Due To Entanglement

This scenario suggests that all bass captured in gill nets eventually die as a result of entanglement,

(B) 75% Mortality Due To Entanglement

Our observations on board commercial vessels revealed that 57% of the bass were still alive when removed from the nets. The great majority of these fishermen waited until the nets were overhauled before removing the bass. Therefore, if all live bass were released, the survival rate of entangled bass under this scenario could be:

(57% alive) x (42% survival; Section 3.3) = 24%

Thus, the mortality rate under this scenario is about 75%.

(C) 48% Mortality Due To Entanglement

If fishermen were to remove all entangled bass at the puller, it follows from Section 3.3 that the survival of bass could be:

(77% alive) x (67% survival) = 52%

Thus, the mortality rate would be 48%.

The above 3 mortality rates yield the following estimated kills under effort levels prevailing in 1987 or 1986 (effort levels in 1986 and 1985 are virtually identical, so only the 1986 level is considered hereafter):

EFFORT YEAR	ESTIMATED SMALLMOUTH BASS KILLS UNDER 3 DIFFERENT MORTALITY RATES		
	100%	75%	48%
1987	11,414	8,561	5,479
1986	26,507	19,880	12,723

3.6 ESTIMATED KILLS DUE TO ANGLING

Creel surveys carried out annually between 1978 and 1987 (Table 5) suggest that, on average, an estimated 55,030 bass are harvested per year. This harvest was distributed by age as follows:

AGE	HARVEST
2	1,761
3	17,445
≥ 4	35,824

In general, success rates by smallmouth bass anglers in Long Point Bay have increased during the 1978-1987 period (Table 5). In 1987, angler success rates reached 0.442 bass per rod hour.

3.7 VITAL STATISTICS

Vital statistics of the smallmouth bass population were calculated using catch and age distribution data from annual creel surveys carried out in Long Point Bay between 1979 and 1987 (Table 5). In addition, growth parameters of the von Bertalanffy model were calculated by the method of Bayley (1977), using weighted mean backcalculated lengths at age provided in MacGregor and Witzel (1987) for trapnet data pooled over the years 1980-1983.

A. Mortality

Total instantaneous mortality (Z) was estimated by simple catch curve analyses (Ricker 1975) using pooled catch at age data from creel surveys carried out between 1979 and 1987 (Table 5). Inspection of the catch curve (Figure 10) revealed that bass were not fully recruited into the sport fishery until age 4; regression analysis on the descending right limb of this curve yielded the following equation:

$$\text{Log}_e \text{ Catch} = -0.790 \text{ (AGE)} + 0.899 \qquad R^2 = 0.988$$

Thus, Z = 0.79.

Natural mortality (M) was estimated by the method of Pauly (1984) as:

$$\text{Log } M = -0.0066 - 0.279 \text{ Log } L_\infty + 0.654 \text{ Log } K + 0.463 \text{ Log } T$$

where: L_∞ and K are parameters of the von Bertalanffy growth equation, (estimated to be 50.1 cm and 0.192 respectively for smallmouth bass in the Nanticoke region of Long Point Bay)

:T = mean annual water temperature = 9.0°C (derived from water intake temperatures at the Nanticoke Thermal Generating Station).

Substituting in the above equation, the estimated natural mortality rate (M) = 0.31.

Fishing mortality rate was assumed to be:

$$F = Z - M = 0.79 - 0.31 = 0.48/\text{year}$$

Since fishing mortality essentially occurs over a 3 month fishing period (July - September) the natural mortality coefficient for the fishing season is 0.25 yrs x 0.31 = 0.078

B. Reconstructed Bass Populations

The fully catchable segment of the bass population by the sport fishery consists of age groups 4 and older. All of these age groups suffer the same annual total mortality (Z = 0.79).

By assuming constant recruitment at age 4, then the number of bass aged ≥4 can be approximated by:

$$N_{\geq 4} = N_4 \left(\frac{1}{1 - e^{-Z}}\right) = N_4 \ (1.846)$$

Also:

$$C_{\geq 4} = N_{\geq 4} \left(\frac{F_{\geq 4}}{F_{\geq 4} + M/4}\right) \cdot \left(1 - e^{-(F_{\geq 4} + M/4)}\right)$$

$$= N_{\geq 4} \ (0.368)$$

where: $C_{\geq 4}$ = the average number of bass aged 4 and older that were killed by anglers = 35,824

$F_{\geq 4}$ = fishing mortality rate for aged 4 and older bass = 0.48/year

Therefore, the average number of bass aged 4 and older is:

$$N_{\geq 4} = (C_{\geq 4}) \times \frac{1}{0.368} = 97,334$$

The average number of bass recruiting to the sport fishery at age 4 is:

$$N_4 = \frac{N_{\geq 4}}{1.845} = 52,756$$

From this point, the numbers of age 2 and 3 year old bass were calculated by assuming that gillnet kills have been and will remain at the sustained kills estimated earlier (Section 3. 5). These calculations were carried out for each of the 3 mortality rates due to entanglement (ie. 100%, 75% and 48%) and for the two effort levels (ie. 1987 and 1986). Sample calculations are available in Appendix Table II; these were of the following general forms:

C^n_{tot} = Total Kill at Age n = $C^n_{anglers} + C^n_{gillnet}$

N_{n+1} = Estimated number of aged n+1 bass in the population

$C^n_{tot} / N_{n+1} = X$

Also: $$\frac{C^n_{tot}}{N_{n+1}} = (e^{F^n_{tot} + M}) \cdot \left(\frac{F^n_{tot}}{F^n_{tot} + M/4} \right) \cdot \left(1 - e^{-(F^n_{tot} - M/4)} \right)$$

By iteration, a value for F^n_{tot} that yields x can be found.

Then:

$$N_n = C^n_{tot} \cdot \left(\frac{F^n_{tot} + M/4}{F^n_{tot}} \right) \cdot \left(\frac{1}{1 - e^{-(F^n_{tot} - M/4)}} \right)$$

Using the above calculations, the reconstructed long-term status of the age 2 and older bass populations under the various estimated kill regimes due to gill nets are:

EFFORT YEAR	AGE	Estimated Population Sizes Using 3 Mortality Rates Due to Entanglement 100%	75%	48%
1987	2	139,501	132,473	132,092
	3	95,645	94,223	92,882
	>4	97,334	97,334	97,334
	2 - 4 +	332,480	324,030	322,308
	2 - 3	235,146	226,696	224,974
1986	2	155,450	149,176	140,318
	3	103,421	99,848	96,496
	> 4	97,334	97,334	97,334
	2 - 4 +	356,205	346,358	334,148
	2 - 3	258,871	249,024	236,814

Note: There is no direct relationship between the mortality rates and estimated population sizes. The decline in population size with declining mortality rates simply means that with lower fishing mortality, fewer recruits were needed to begin with to supply the 4 year old segment.

C. Reducing Incidental Kills To Zero

Incidental kills remove bass almost entirely from the 2-and 3- year old segment. Under 1987 effort levels, these kills represent between 2.4 and 4.9% of the total number of bass in this segment; under 1986 effort levels, the kills represent between 5.4 and 10.2% of the segment (Table 6).

To evaluate the impact of incidental kills on the fully catchable (by anglers) segment of the population, the gillnet mortality was reduced to zero, and the numbers of age 4 and older bass were again estimated for populations previously exposed to the various kill regimes.

In so doing, it was assumed that:

(1) M and $F_{angling}$ remained constant, and

(2) that recruitment at age 2 remained fixed at the levels estimated in Table 6.

The results of these calculations are in Table 7. (See also Appendix Table II).

The magnitude of increase in the age 4 and older segment varied from 6.4 to 27.3% depending on the mortality regime to which the population had been exposed previously (Table 7). Under the 75% mortality regime, which appears to reflect current fishing practices, the catchable segment is predicted to increase by 7.2% (assuming 1987 effort levels were the most representative of past conditions), or 21.4% (assuming that 1986 effort levels were most representative).

4.0 DISCUSSION

4.1 ESTIMATED CATCHES AND KILLS

In 1987, the critical period of vulnerability of smallmouth bass to commercial gill net in Areas 1 and 2 was identified to be between July 1 and September 30, 1987. Previous impressions of anglers and OMNR staff were that bass were most susceptible between the last week in July and the end of August (MacGregor 1987). The rationale for this argument was that bass leave their spawning grounds in the Inner Bay during this period to seek the cooler waters of the outer bay. Shifts in the distribution of angler success during this period from the Inner Bay to deeper outer bay waters are commonly observed in OMNR creel surveys (MacGregor and Witzel, 1987), and support the contention of such mid-summer emigrations. If this hypothesis is true, then the time of departure from Inner Bay spawning areas will depend on weather conditions (particularly water temperatures) prevailing during a given spawning year. Further support for this contention was found during another study carried out concurrently with this investigation in 1987. During this study (Witzel 1988), which was designed to document bass spawning areas and monitor the progress of spawning in Long Point Bay, it was found that the end of spawning activity in the Inner Bay corresponded well with the first appearance of bass in our gill nets (June 18).

For the purpose of this report, it was assumed that the critical period (July - September) applied to the entire bay, and estimates of total incidental catches for the entire bay were based on this assumption. However, it must be emphasized that presently we have no

information concerning incidental catches of bass in Area 3 prior to July 1; thus, the validity of applying the critical period identified in Areas 1 and 2 to Area 3 is in doubt. Clearly, we know that bass are at least as vulnerable during the critical period in Area 3; but, we do not know the beginning nor end of the critical period in Area 3. Nevertheless, based on this critical period, estimated annual catches of smallmouth bass in commercial gill nets ranged from 11,414 to 26,533 bass for the entire bay, depending on the total effort level used as the expansion factor. Catches of bass per unit of gillnet effort are some 30% higher in Area 3 than in Areas 1 and 2 combined; however, under past effort conditions (i.e. 1985 or 1986), the total incidental catch would be split almost equally between Areas 1 and 2 combined, and Area 3. Because of a shift in the distribution of commercial effort away from the original study area (Areas 1 and 2) to Area 3, (see Appendix Figures I-IX), catches of bass were considerably higher in Area 3 in 1987 than in previous years. (Area 3 accounted for some 66% of the total incidental catch under 1987 effort conditions, as opposed to 48% under pre-1987 effort conditions).

While admittedly crude, our examinations of potential survival of bass upon release from gill nets suggest that many bass would survive, particularly if removed and released at the puller. Thus, our estimates of incidental catch do not necessarily equate to complete kills (i.e. 100% mortality). There remains considerable uncertainty concerning the actual, day-to-day practices by the commercial fishermen in handling and releasing the entangled bass. As these practices strongly dictate what the actual kill would be, incidental kills were estimated under the three mortality rates

described in Section 3.5 (i.e. 100%, 75% and 48% mortality). The estimated kills ranged widely across the three mortality rates (26,507 at 100%, 19,880 at 75% and 12,723 at 48%, using 1986 effort levels). The 75% mortality rate was estimated from observations on-board commercial vessels and extrapolations to the results of our survival studies carried out during simulated fishing. While this rate would seem to reflect present practices, its validity is still questionable. Our staff may have biased the handling procedures in two opposing ways: (a) by their physical presence, which may have lead some fishermen to be more careful than usual in handling bass, and (b) by the fact that most fishermen came to know that we would eventually request the bass for sampling purposes, this may have lead others to be less careful than normal.

The 48% mortality rate was derived completely from the results of simulated commercial fishing, and requires that all live bass be removed and released as the nets come on-board. This may not be achievable by all fishermen all of the time; other factors such as the size of the total catch, weather, and techniques used by individual pickers will tend to reduce the percentage of bass that can be removed as the nets come on board.

These uncertainties, in addition to those surrounding our rather crude techniques used to determine survival of entangled bass, emphasize that while the estimated catches are reasonably sound, the estimated kills should be viewed as scenarios, not as hard and fast numbers.

4.2 POTENTIAL EFFECTS OF ELIMINATING INCIDENTAL KILLS

The effects of incidental kills on the structure of the bass population were examined by first constructing the bass populations under the various mortality regimes (assuming that the kills had been sustained at these levels annually for many years). The magnitude of change in the population size and stucture that might be expected by eliminating the incidental catch then was examined by reconstructing the bass populations with fishing mortality due to gill nets reduced to zero. In this context, it was decided that the magnitude of change in the fully catchable (by anglers) segment of the population (age $\geq$ 4) would be most meaningful.

While gill nets remove bass almost exclusively from the age 2- and 3-year old segment of the population (about 8% of the age 2-3 bass are estimated to be killed annually by gill nets under the 1986 effort levels), these removals do influence the fully catchable segment. The projected percent increase in the fully catchable segment ranged widely (from 6.4 - 27.3%) depending on the mortality regime selected (Table 7). As the effort levels prevailing in 1986 or 1985 are most representative of the commercial fishery over the past ten years, then the bass population has more likely experienced incidental kills at the levels predicted under the 1986 scenario, than that for 1987. Furthermore, as noted in 4.1, our best approximations to true mortality rates due to entanglement is 75%. Therefore, an increase of some 21% (Table 7) in the catchable segment of the population might be the most reasonable expectation if the incidental kill was eliminated.

4.3 THE SPORT FISHERY

Long Point Bay sustains one of the best sport fisheries for smallmouth bass in Ontario. Compared to other surveyed bass fisheries in the province, Long Point Bay by far ranks first in terms of yield (kg of bass/hectare of water), and ranks fourth in terms of angler success rates (bass harvested per rod-hour of fishing, HUE) (Table 8). An average of some 55,030 bass are estimated to be harvested from Long Point Bay annually; this amounts to an annual removal of some 37% of the fully catchable segment of the population. Until recently, all of the bass were harvested near or in the Inner Bay. On the other hand, about half of the estimated incidental catch of bass in commercial gill nets occurs in waters well removed from the Inner Bay (Area 3, Figure 3) where angling has been negligible. Thus, it may appear that incidental bass catches occurring some 40 km away from the Inner Bay are of little consequence to the sport fishery. However, previous work (MacGregor and Witzel 1987 and references therein), while inconclusive, has shown that many bass move from areas as far away as Peacock Point to the Inner Bay during the spawning season (Figure 11) (Inner Bay is the only major bass spawning area known in Long Point Bay). This, combined with mounting evidence that bass move from the Inner Bay to the deeper outer bay after spawning, suggests that bass inhabiting Area 3 cannot be isolated as non-contributors to the sport fishery in the Inner Bay. In fact, the sport fishery is strongly dependent on the residual spawners in the Inner Bay after opening day of bass season. The vast majority of the bass are taken in the first two weeks after opening day when some males are still guarding broods in the Inner Bay. Angler success rates decline rapidly thereafter as

bass move out into deeper waters.

The only other known spawning area within Long Point Bay occurs in a limited area within the discharge channel of the Nanticoke Thermal Generating Station (NTGS) (MacGregor and Witzel, 1987). Recently, anglers have been experiencing excellent bass fishing in Area 3 at the NTGS where the heated water outfall tends to attract bass (CUE's and yield here are actually comparable or higher than those in the Inner Bay, Table 8).

This fishery is expected to increase in importance as the area becomes more widely known, and as access to these waters is improved. Thus, in this context, the effects of incidental bass catches on angling in Area 3 are also relevant.

4.4 MANAGEMENT IMPLICATIONS

The term "incidental catch" recently has become strongly linked to perceived detrimental effects of accidental sport fish catches in commercial gill nets. However, incidental catches are not exclusive to this gear; virtually any fishing gear will catch fish other than the target species. This includes angling gear; a bass may be taken by hook and line during closed season while fishing for some other legal species. This is also an "incidental catch". In the past, anglers fishing in the Inner Bay prior to opening day of bass season frequently experienced incidental catches of male bass guarding nests. This guarding behaviour of male bass makes them particularly vulnerable to incidental catches by anglers at this time. Recently the OMNR implemented a sanctuary in the Inner Bay (Appendix Figure X),

which is designed to protect spawning bass from incidental angling catches. Anglers subsequently argued that incidental catches of bass in gill nets were far more damaging to the bass population. (MacGregor 1987).

It has been the task of this study to estimate more clearly the incidental catch and kill of bass in commercial gill nets. We have succeeded in identifying the period of vulnerability by bass to commercial gill nets in 1987, and hence have been able to estimate the total, annual incidental catch. It should be emphasized that the critical period of vulnerability may change from year-to-year depending on prevailing weather (particularly water temperatures). A warm spring and summer could lead to earlier spawning and earlier emigration from the Inner Bay. Earlier emigrations would advance the beginning of the critical period. The factors directing the end of the critical period are less clearly understood because we lack information concerning the movement patterns of bass in the fall. However, for whatever reason, the end of the critical period would also seem to be related to temperature. Hence, a warm fall would extend the end of the critical period. The general concensus is that 1987 was a particularly warm year with an early spring and late fall. Thus, the critical period identified in 1987 may be one of the broader of the scenarios that may develop. Clearly, the duration of the critical period will influence the annual level of the incidental catch.

In addition, we have demonstrated that the level of commercial gillnet effort prevailing in Long Point Bay during the critical period will very strongly dictate the total catch, as will the locations in which

fishermen set their nets at this time. Under current fishing practices, effort levels prevailing in the pre-1987 period would yield incidental catches of some 26,500, bass which we suggest may amount to a kill of about 19,000 bass. In a population of some 350,000 age 2 and older bass, which has sustained an annual angler harvest of 55,030 bass over the past decade (and clearly has been subject to incidental catches in gill nets for years), the obvious question is: "of what importance is the incidental kill to the sport fishery?". The available information suggests that the fully catchable segment of the bass population may increase by some 7 to 21% if incidental catches in gill nets were eliminated. At this time, it is unclear to what extent the sport fishery would benefit from reduced incidental kills. Presently, we know very little about the behaviour and distribution of the bass population; thus, it is difficult to predict what the consequences of an increase of 21% in the catchable stock would be to the Inner Bay sport fishery. If the angling community were able to take advantage of this increased population regardless of its eventual distribution within the bay, then an increase in harvest and angler success rates could be expected.

Biological data concerning the status of the bass population is limited, but existing information does not suggest that current levels of incidental kills in gill nets place the population at risk. The population has sustained this mortality for years with no apparent decline in yield or angler success rates. A total mortality rate of $Z = 0.79$ is not unusual for bass populations and several have sustained higher rates for many years (B.J. Shuter, personal comm., 1988).

The implications of eliminating incidental kills in gill nets largely involve improving what is already the best bass sport fishery in the province by a limited margin. It should be clearly pointed out that our estimates of population size are very crude, relying largely on various sources of information, all of which have wide margins of error associated with them. More refined estimates of population size to ground truth our projections are highly recommended before any strong management action is implemented on this basis alone.

The results of this investigation suggest that there are means within Long Point Bay to reduce the incidental catch or kill of bass without an outright ban on commercial fishing. For instance, our data suggests that restricting gill nets to deeper water during the critical period would reduce bass CUE's while still enabling gill netters to catch perch. If it is considered necessary to reduce incidental catches of bass, then the following options should be considered, most of which involve reducing the frequency of encounters:

a) restrict gill netting in Areas 1 and 2 to deeper waters (at least during the critical period),

b) obtain further estimates of incidental catches in Area 3 where we have no previous information,

c) define the critical period and area(s) of vulnerability by bass to gill nets in Area 3 (there are reasons to expect that this period will be substantially different in these waters than in Areas 1 and 2)

d) based on (c) consider restricting gill netting in waters of Area 3 to defined areas, at least during the critical period

e) emphasize to commercial fishermen the benefits of releasing live bass carefully back to the water whenever possible.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The basic conclusion of this report is that under the reduced commercial effort levels in 1987 some 11,414 bass were captured incidentally in commercial gill nets. Under past effort levels (1985 or 1986) we predict that catches would have approached some 26,500 bass. Placed in the context of the total population size, it appears that these catches approach some 5 to 10% of the age 2- and 3- year old segment of the population. Under current fishing practices, some 25% of these bass could survive upon release; thus, estimated catches do not necessarily equate to complete kills. Additional computations suggest that removal of the incidental kill could yield an increase of up to 21% of the fully catchable stock. (Table 7).

To estimate population sizes, derive mortality rates, and discuss movement patterns, considerable information was drawn from other sources. As these sources were not designed to yield this kind of information, the results must be interpreted with caution. To increase our understanding of incidental catches and their effects on the bass population, the following additional studies are highly recommended:

a) Since 1987 was the first year in which we were able to estimate catches for the entire bay, it is recommended that one additional year of sampling be carried out to confirm the estimates. This survey should consist of On-Board sampling and should encompass the entire bay.

b) Simulated fishing should be carried out in Area 3 for at least one year to define the critical period of vulnerability in these waters and locate "hot spots within the area where bass catches are highest.

c) Tagging studies of smallmouth bass, which focus on describing the seasonal distribution and

movement of bass within the bay are required to answer questions relating to the importance of bass in Area 3 to the sport fishery.

d) Further work designed to more carefully ascertain potential survival of bass from entanglement would be beneficial in estimating kills.

There is some evidence to suggest that the population of bass is increasing in Long Point Bay. Angler success rates have improved recently in Long Point Bay (Table 5), and the CUE's of bass in commercial gill nets were some 35% higher in 1987 than in the same time period during our On-Board Survey in 1984 (9.7 bass/km and 6.4 bass/km respectively).

While these comparisons are only rough indicators of relative population size, it is possible that incidental catches are increasing as the population expands. However, assuming that vulnerability to gill nets remains unchanged, then the total proportion of bass removed from the population by gill nets should also remain unchanged. Because we lack good indicators of bass abundance and recruitment in Long Point Bay, any questions regarding the current or predicted status of the population cannot be addressed adequately with existing information.

Throughout the course of this investigation it has become clear that better information concerning the biology of smallmouth bass in Long Point Bay is necessary to address management issues such as the one posed in this report. More precise information is required to answer such basic biological questions as:

a) Is the bass population stressed, and if so, what are the causes?,

b) What is the size of the bass population in Long Point Bay?,

c) Do all smallmouth bass spawn within the Inner Bay or are there other areas of importance to the population,

d) Is the bass population expanding or declining?,

e) What are the best management options to protect or improve the bass population?,

f) What will the bass fishery be like 3 or 4 years hence?,

g) Did year "n" produce a good or poor year class of bass?

All of these are important questions that are posed to us frequently. Information derived from creel surveys can provide some information pertaining to these questions; but, as Shuter et al (1987) have succinctly shown, information so derived can be extremely misleading without other supporting data. Currently, we lack the ability to answer most of these questions with any reasonable confidence.

In view of the magnitude and provincial importance of this fishery, it is highly recommended that an index fishing program which focuses on the bass population be implemented. This program will yield good basic biological information concerning abundance, growth, mortality, and recruitment of smallmouth bass; however, a long-term financial committment to such a program is required for it to be of value.

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Table 1. Sampling schedule and numbers of fish captured per kilometer of gill net in simulated commercial fishing, Long Point Bay, 1987.

		CUE (fish/km)				
DATE	LOCATION	SMALLMOUTH BASS	YELLOW PERCH	WHITE PERCH	TOTAL NON-TARGET	ALL FISH
April 25	A02	0	388	44	50	437
	B02	0	436	16	18	454
	C02	0	312	15	18	330
	A04	0	386	22	28	414
April 28	A18	0	114	9	9	123
	B18	0	99	19	19	118
	C18	0	163	27	27	189
	A20	0	303	33	32	337
April 30	A11	0	264	323	353	617
	A06	0	110	54	54	164
May 8	A30	0	827	2525	2548	3374
	A27	0	520	1029	1144	1664
May 14	A21	0	291	320	320	611
	B21	0	285	202	202	488
	C21	0	313	114	116	429
	A24	0	334	202	204	538
May 21	A04	0	104	761	785	890
	B04	0	81	586	590	671
	C04	0	61	582	585	646
	A09	0	75	1287	1335	1410
May 22	A33	0	133	470	489	621
	A30	0	176	290	301	477
May 26	A23	0	112	71	71	183
	B23	0	101	53	54	158
	C23	0	82	31	31	113
	A31	0	209	1842	1921	2130
May 28	A05	0	52	367	405	456
	B05	0	19	59	62	81
	C05	0	37	52	54	91
	A07	0	59	337	371	430
June 4	A10	0	149	437	565	714
	B10	0	102	251	286	389
	C10	0	114	171	189	304
	A15	0	71	110	120	191
June 10	A25	0	138	425	443	581
	B25	0	160	594	617	777
	C25	0	128	232	247	374
	A27	0	121	503	535	657
June 11	A13	0	43	345	350	393
	B13	0	32	238	256	288
	C13	0	27	222	237	264
	A16	0	52	424	429	481
June 17	A34	0	257	626	715	972
	B34	0	162	484	524	686
	C34	0	138	163	169	307
	A32	0	301	675	710	1010
June 18	A08	1	13	66	87	100
	B08	0	6	20	22	28
	C08	0	7	8	10	17
	A12	1	16	97	149	165
June 24	A17	10	49	274	348	397
	B17	7	58	207	277	335
	C17	3	98	26	80	178
	A01	44	150	220	354	504
June 25	A35	1	294	115	198	492
	B35	0	439	58	144	583
	C35	0	562	93	152	714
	A26	0	317	168	262	579
June 30	A06	0	317	26	30	347
	B06	0	70	10	11	81
	C06	0	50	14	21	71
	A02	1	81	33	46	130

..... continued

Table 1 continued ...

DATE	LOCATION	CUE (fish/km) SMALLMOUTH BASS	YELLOW PERCH	WHITE PERCH	TOTAL NON-TARGET	ALL FISH
July 1	A20	0	225	9	24	249
	B20	0	99	7	8	107
	C20	0	88	6	12	100
	A28	0	55	22	29	84
July 8	A03	76	64	29	206	270
	B03	26	28	33	107	136
	C03	12	37	63	150	187
	A12	62	74	17	241	315
July 9	A29	0	317	145	235	552
	B29	0	139	59	136	274
	C29	0	193	179	244	437
	A25	0	78	27	59	137
July 15	A27	10	146	723	844	990
	B27	2	213	672	776	989
	A24	2	109	392	468	577
July 16	A18	7	56	29	92	148
	B18	2	35	18	64	99
	C18	2	40	24	53	93
	A14	6	67	68	139	205
July 21	A07	18	56	36	182	238
	B07	11	37	69	183	221
	C07	7	33	88	217	250
	A14	6	133	43	221	353
July 22	A34	11	103	482	843	946
	B34	6	204	356	612	816
	C34	2	245	242	389	634
	A21	5	99	17	89	188
July 29	A18	16	43	35	77	120
	B18	10	48	55	87	135
	C18	10	41	25	61	102
	A10	16	41	32	94	136
July 30	A26	6	28	26	51	79
	B26	6	43	41	68	110
	C26	16	50	175	221	270
	A35	36	130	173	466	595
Aug. 5	A23	5	68	79	182	250
	B23	6	53	102	192	215
	C23	11	62	120	221	282
	A31	23	200	857	990	1190
Aug. 11	A03	22	24	47	238	284
Aug. 12	A17	46	62	891	1207	1269
	B17	24	57	569	795	851
	C17	24	51	454	664	715
Aug. 14	A08	4	29	335	556	585
	B08	8	25	350	553	578
	C08	16	35	296	465	500
	A15	26	61	456	619	680
Aug. 18	A13	20	39	233	421	461
	B13	11	24	163	347	371
	C13	21	36	291	526	563
	A19	22	174	825	1174	1348
Aug. 19	A32	6	130	479	987	1116
	B32	2	463	529	902	1364
	C32	5	759	655	975	1731
	A28	15	51	734	1105	1156

..... continued

Table 1 continued ...

DATE	LOCATION	CUE (fish/km) SMALLMOUTH BASS	YELLOW PERCH	WHITE PERCH	TOTAL NON-TARGET	ALL FISH
Aug. 20	A27	4	147	1087	1318	1465
	B27	2	83	667	1021	1104
	A33	2	159	642	1305	1464
Aug. 26	A01	10	29	15	69	98
	B01	26	77	6	79	156
	C01	8	88	15	82	170
	A05	23	83	64	111	194
Aug. 27	A20	9	203	2145	2396	2599
	B20	6	169	1885	2091	2260
	C20	6	142	1423	1715	1856
	A22	14	172	1896	2344	2516
Sept. 3	A11	46	36	156	720	756
	A16	76	47	916	1318	1364
Sept. 9	A06	22	18	46	194	213
	C06	12	6	27	78	84
	A09	31	23	31	157	180
Sept. 16	A19	7	23	284	562	585
	B19	13	57	250	544	600
	A17	13	21	159	460	481
Sept. 22	A33	1	88	106	561	649
	B33	0	94	286	653	747
	A29	0	22	41	609	632
Sept. 23	A21	5	30	318	530	561
	B21	5	41	415	688	730
	A22	0	80	408	733	813
Sept. 24	A02	19	36	29	275	312
	B02	11	18	20	300	318
	A09	68	26	24	322	348
Oct. 1	A16	6	60	146	891	950
	C16	11	23	82	587	610
	A14	13	11	68	653	664
Oct. 7	A01	24	67	130	406	473
	B01	34	63	200	567	630
	A04	14	66	88	275	341
Oct. 8	A13	0	106	141	275	382
	C13	0	98	531	635	733
	A10	0	46	90	336	382
Oct. 14	A31	0	62	19	29	90
	B31	0	170	38	51	221
	A35	0	85	50	94	179
Oct. 15	A23	0	502	53	118	620
	C23	0	311	47	93	431
	A26	0	114	31	36	151
Oct. 16	A03	0	16	0	4	20
	B03	0	9	1	4	13
	A05	0	32	5	49	81
Oct. 20	A11	0	13	3	58	71
	B11	0	20	1	17	37
	A08	0	19	6	34	54
Oct. 23	A07	0	4	0	4	8
	B07	0	10	0	19	29
	A02	0	18	0	29	48
Oct. 29	A12	0	6	0	8	14
	C12	0	3	0	3	6
	A15	0	2	0	6	8
Pooled Locations		8	136	275	396	532

Table 2. Sampling schedule, gillnet effort, catches and CUE's of smallmouth bass and yellow perch observed in actual catches by commercial fishermen, Areas 1 and 2, Long Point Bay, 1987.

				SMALLMOUTH BASS				YELLOW PERCH			
						CUE				CUE	
FISHERMAN NUMBER	LIFT DATE	GRID LOC.	EFFORT (km)	Total No.	Total Wt. (kg)	No/km	kg/km	Total[1] No.	Total Wt. (kg)	No/km	kg/km
1	May 6	110	3.655	0	0.0	0.0	0.0	2496	272.1	682.9	74.4
2	May 8	111	1.460	1	0.9	0.7	0.6	541	59.0	370.5	40.4
3	May 13	110	2.011	0	0.0	0.0	0.0	1502	163.3	746.9	81.2
4	May 14	137, 138	5.165	0	0.0	0.0	0.0	1581	172.3	306.1	33.4
5	May 22	111	2.160	0	0.0	0.0	0.0	1165	127.0	539.4	58.8
6	May 28	111, 139	4.045	0	0.0	0.0	0.0	1518	165.5	375.3	40.9
9	July 8	137, 138	4.680	6	1.9	1.3	0.4	832	90.7	177.8	19.4
10	July 9	110	3.655	15	2.6	4.1	0.7	791	86.2	216.4	23.6
12	July 14	110, 137	5.825	2	0.3	0.3	0.1	832	90.7	142.8	15.6
13	July 15	110	3.895	35	4.7	9.0	1.2	1914	208.6	491.4	53.6
14	July 16	110	5.650	52	7.8	9.2	1.4	1664	181.4	294.5	32.1
17	July 21	94	2.685	52	6.0	19.4	2.2	936	102.0	348.6	38.0
20	July 23	137	6.325	8	2.3	1.3	0.4	2496	272.1	394.6	43.0
21	July 23	110	6.005	24	2.8	4.0	0.5	2545	277.3	423.8	46.2
24	July 28	110	4.195	22	2.7	5.2	0.6	2205	240.4	525.6	57.3
26	July 29	94	3.015	3	0.4	1.0	0.1	1574	171.6	522.1	56.9
27	July 30	137, 138	5.655	71	9.8	12.6	1.7	1248	136.1	220.7	24.1
28	July 30	110, 137	6.745	113	14.9	16.8	2.2	1248	136.1	185.0	20.2
29	Aug. 4	110	3.835	44	7.0	11.5	1.8	707	77.1	184.4	20.1
30	Aug. 4	139	2.270	7	1.0	3.1	0.4	1052	112.2	463.4	49.4
37	Aug. 12	94, 111	3.260	5	0.6	1.5	0.2	520	56.7	159.5	17.4
41	Aug. 26	111	1.140	26	2.8	22.8	2.5	125	13.6	109.6	11.9
56	Sept. 24	94	3.470	18	2.5	5.2	0.7	1040	113.4	299.7	32.7
POOLED LOCATIONS (May-September)			90.801	504	71.0	5.6	0.8	30532	3325.4	336.3	36.6
POOLED LOCATIONS (July-September)			72.305	503	70.1	7.0	1.0	21729	2366.2	300.5	32.7

[1] Number of yellow perch estimated from landed weight (average weight = 109 g).

Table 3. Sampling schedule, gillnet effort, catches and CUE's of smallmouth bass and yellow perch observed in actual catches by commercial fishermen, Area 3, Long Point Bay, 1987.

FISHERMAN NUMBER	LIFT DATE	GRID LOC.	EFFORT (km)	SMALLMOUTH BASS				YELLOW PERCH			
				Total No.	Total Wt. (kg)	CUE		Total[1] No.	Total Wt. (kg)	CUE	
						No/km	kg/km			No/km	kg/km
7	July 1	95	0.725	0	0.0	0.0	0.0	1040	113.4	1434.5	156.4
8	July 7	112	3.615	1	0.1	0.3	0.03	250	27.2	69.2	7.5
11	July 10	112	3.965	0	0.0	0.0	0.0	416	45.4	104.9	11.5
15	July 17	95	3.115	47	4.9	15.1	1.6	416	45.4	133.5	14.6
16	July 20	95	1.015	0	0.0	0.0	0.0	416	45.4	409.9	44.7
18	July 21	96	5.375	132	14.4	24.6	2.7	1664	181.4	309.6	33.7
19	July 22	95	1.055	3	0.3	2.8	0.3	832	90.7	788.6	86.0
21	July 23	94	1.360	11	1.3	8.1	1.0	576	62.8	423.5	46.2
22	July 24	96, 97	7.280	84	9.0	11.5	1.2	3661	399.1	502.9	54.8
23	July 27	95	1.305	4	0.3	3.1	0.2	1394	151.9	1068.2	116.4
25	July 28	96, 97	8.120	104	11.9	12.8	1.5	3329	362.8	410.0	44.7
26	July 29	94	2.205	39	5.1	17.7	2.3	1151	125.5	522.0	56.9
30	Aug. 4	112	2.320	4	0.5	1.7	0.2	1029	114.6	443.5	49.4
31	Aug. 5	95, 112	7.389	25	4.7	3.4	0.6	832	90.7	112.6	12.3
32	Aug. 6	112	3.605	27	4.2	7.5	1.2	312	34.0	86.5	9.4
33	Aug. 7	95	5.128	225	28.5	43.9	5.6	749	81.6	146.1	15.9
34	Aug. 7	94, 95	1.995	17	2.4	8.5	1.2	312	34.0	156.4	17.0
35	Aug. 10	95	1.060	3	1.2	2.8	1.1	208	22.7	196.2	21.4
36	Aug. 11	95, 113	3.468	8	0.9	2.3	0.3	612	66.7	176.5	19.2
38	Aug. 18	113	4.528	3	0.7	0.7	0.2	541	59.0	119.5	13.0
39	Aug. 19	112, 113	3.520	3	0.5	0.9	0.1	2080	226.8	590.0	64.4
40	Aug. 20	95	1.150	15	1.5	13.0	1.3	270	29.5	234.8	25.7
42	Aug. 28	112, 113	3.980	18	3.2	4.5	0.8	624	68.0	156.8	17.1
43	Sept. 2	112	3.605	0	0.0	0.0	0.0	1040	113.4	288.5	31.5
44	Sept. 3	96, 113	2.830	19	2.5	6.7	0.9	832	90.7	294.0	32.0
45	Sept. 4	95	3.909	44	8.4	14.2	2.7	541	59.0	175.1	19.1
46	Sept. 9	96	0.670	4	8.8	6.0	13.1	83	9.1	123.9	13.6
47	Sept. 10	96, 113	3.120	40	5.2	12.8	1.7	541	59.0	173.4	18.9
48	Sept. 10	112, 113	3.445	40	5.9	11.6	1.7	1456	158.7	422.6	46.1
49	Sept. 11	112	2.980	50	6.2	16.8	2.1	541	59.0	181.5	19.8
51	Sept. 15	113	3.130	52	6.4	16.6	2.0	416	45.4	132.9	14.5
52	Sept. 15	94	1.555	21	2.6	13.5	1.7	208	22.7	133.8	14.6
53	Sept. 16	112, 113	3.480	8	2.1	2.3	0.6	666	72.6	191.4	20.9
55	Sept. 22	95	4.170	23	2.7	5.5	0.6	333	36.3	79.9	8.7
57	Sept. 25	94	1.515	26	3.8	17.2	2.5	666	72.6	439.6	47.9
POOLED LOCATIONS			110.868	1100	150.2	9.9	1.4	30037	3277.1	270.9	29.6

[1] Number of yellow perch estimated from landed weight (average weight = 109 g).

Table 4. Percent of entangled smallmouth bass alive (A) at the puller, and (B) after the entire strap was on board and picked, 1987 simulated commercial fishing, Long Point Bay, Lake Erie.

A.				B.		
		ASSESSED AT PULLER			ASSESSED AFTER STRAP ON BOARD AND PICKED	
DATE	NO. BASS ENTANGLED	NO. ALIVE	% ALIVE	NO. BASS ENTANGLED	NO. ALIVE	% ALIVE
June 18	2	2	100.0	0	-	-
June 24	17	14	82.3	46	43	93.5
June 25	1	1	100.0	0	-	-
June 30	0	-	-	1	1	100.0
July 8	38	35	92.1	136	120	88.2
July 15	10	6	60.0	4	1	25.0
July 16	9	8	88.9	8	6	75.0
July 21	25	24	96.0	17	4	23.5
July 22	13	10	76.9	11	4	36.4
July 29	26	20	76.9	26	21	80.8
July 30	22	18	81.8	42	20	47.6
Aug. 5	0	-	-	45	0	0.0
Aug. 11	0	-	-	22	16	72.7
Aug. 14	20	15	75.0	31	10	32.2
Aug. 18	41	24	58.5	33	7	21.2
Aug. 19	11	6	54.5	17	4	23.5
Aug. 20	4	1	25.0	4	1	25.0
Aug. 26	18	16	88.9	49	45	91.8
Sept. 3	45	28	62.2	75	56	74.7
Sept. 9	22	18	81.8	43	33	76.7
Sept. 16	7	6	85.7	25	6	24.0
Sept. 23	5	5	100.0	5	1	20.0
Sept. 24	19	15	78.9	79	50	63.3
Oct. 1	17	16	94.1	13	2	15.4
Oct. 7	24	17	70.8	49	43	87.8
POOLED	396	305	77.0	781	494	63.2

Table 5(a). Estimated catches, harvests and observed catches per rod-hour (CUE) of smallmouth bass by anglers seeking bass in Long Point Bay, 1978-1987. Data are derived from annual creel surveys carried out by OMNR (see MacGregor and Witzel, 1987 for overview of this program).

YEAR	CATCH (NUMBERS)	HARVEST (NUMBERS)	OBS. CUE
1978	49637	41316	0.298
1979	79579	70328	0.356
1980	56226	47306	0.334
1981	63730	56139	0.276
1982	89301	73461	0.352
1983	90052	66712	0.452
1984	61849	43006	0.352
1985	69473	58398	0.419
1986	71262	57322	0.414
1987	50008	36316	0.441

Table 5(b). Age composition (%), mean total lengths (cm) and mean ages (yrs) of angler harvests of smallmouth bass in Inner Long Point Bay, 1979-1987.

	% BY AGE										MEAN AGE	MEAN LENGTH	NO.
YEAR	II	III	IV	V	VI	VII	VIII	IX	X	XI	(YRS.)	(cm)	SAMPLED
1979	1	26	31	22	15	3	2	--	--	--	4.4	29.8	178
1981	1	18	51	18	2	6	3	2	--	--	4.2	31.5	119
1982	29	17	17	24	8	2	--	2	2	--	3.9	29.6	59
1983	4	59	17	13	5	1	--	1	--	--	3.6	28.6	161
1984	1	34	44	6	7	3	1	2	1	--	4.1	30.2	163
1985	--	29	52	15	3	1	--	--	--	--	4.0	29.9	145
1986	--	31	33	30	4	1	--	--	--	--	4.2	30.8	96
1987	4	24	44	10	9	7	1	1	--	--	4.3	31.0	91

Table 6. Ratios of gillnet and angler kills of smallmouth bass to estimated population size.

EFFORT YEAR	RATIO	Mortality Due To Entanglement 100%	75%	48%
1987	Gillnet Kill:Population Size (Age 2 and 3)	4.9%	3.8%	2.4%
	Gillnet Kill:Population Size (Age 2 - 4^+)	3.4%	2.6%	1.7%
	Angler Kill:Population Size (Age $\geq$ 4)	36.8%	36.8%	36.8%
	Angler Kill:Population Size (Age 2 - 4^+)	16.6%	17.0%	17.1%
	Gillnet Kill:Angler Kill	20.7%	15.6%	10.0%
1986	Gillnet Kill:Population Size (Age 2 and 3)	10.2%	8.0%	5.4%
	Gillnet Kill:Population Size (Age 2 - 4^+)	7.4%	5.7%	3.8%
	Angler Kill:Population Size (Age $\geq$ 4)	36.8%	36.8%	36.8%
	Angler Kill:Population Size (Age 2 - 4^+)	15.4%	15.9%	16.5%
	Gillnet Kill:Angler Kill	48.2%	36.1%	23.1%

* Note: age 4^+ means age 4 and older.

Table 7(a). Reconstructed population sizes with gillnet mortality reduced to zero.

Effort Year	Age	PREVIOUS MORTALITY RATE DUE TO ENTANGLEMENT: 100% # at Start of Fishing Season	100% Z	100% S	75% # at Start of Fishing Season	75% Z	75% S	48% # at Start of Fishing Season	48% Z	48% S
1987	2	139,501	0.323	0.724	132,473	0.321	0.725	132,092	0.324	0.723
	3	100,999	0.528	0.590	96,043	0.529	0.589	95,503	0.531	0.588
	4	59,589	0.780		56,569	0.780		56,156	0.780	
	≥4	109,942			104,370			103,608		
1986	2	155,450	0.322	0.725	149,176	0.323	0.724	140,318	0.324	0.723
	3	112,701	0.518	0.596	108,003	0.523	0.593	101,450	0.526	0.591
	4	67,170	0.780		64,046	0.780		59,957	0.780	
	≥4	123,929			118,165			110,621		

Table 7(b). Percent increases in the age 4 and older segment with gillnet mortality reduced to zero.

EFFORT YEAR	MORTALITY RATE OF ENTANGLED BASS	% INCREASE IN AGE 4 AND OLDER POPULATION
1987	100%	13.0%
	75%	7.2%
	48%	6.4%
1986	100%	27.3%
	75%	21.4%
	48%	13.7%

Table 8. Comparative catch and effort statistics for various smallmouth bass sport fisheries in the province of Ontario.

LAKE	TIME PERIOD OF CREEL	YEAR	ALL SPECIES		SMALLMOUTH BASS				
			TOTAL EFFORT	TOTAL YIELD (kg/ha)	OBSERVED CUE (rd-hr)	OBSERVED HUE (rd-hr)	OBSERVED EFFORT (rd-hr)	ESTIMATED EFFORT (rd-hr)	YIELD (kg/ha)
Aylen	April 26 - Oct. 10	1979	4713.00	0.270	0.065	0.065	31.00	911.00	0.010
Aylen	April 26 - Oct. 10	1980	8719.00	0.460	0.167	0.149	54.00	2257.00	0.070
Aylen	April 30 - Oct. 18	1983	5354.00	0.150	0.116	0.116	69.00	1139.00	0.020
Bark	May 19 - Oct. 10	1979	16676.00	0.789	0.114	0.100	70.00	1932.00	0.099
Bark	April 26 - Oct. 10	1980	12854.00	0.300	0.279	0.256	43.00	792.00	0.050
Bark	April 30 - Oct. 18	1983	11997.00	0.286	0.447	0.200		2198.00	0.053
Smoke	April 29 - Oct. 10	1978	9016.00	2.710	0.729	0.176	188.00	3232.00	0.160
Smoke	April 28 - Oct. 10	1979	5989.00	2.050	1.246	0.952	69.00	900.00	0.460
Smoke	April 26 - Oct. 10	1980	7225.00	1.650	1.247	0.110	73.00	1912.00	0.090
Smoke	April 25 - Oct. 10	1981	7665.00	0.950	0.585	0.206	116.00	3375.00	0.240
Smoke	April 24 - Oct. 10	1982	5920.00	0.700	0.524	0.181	111.00	1708.00	0.160
Borden	June 11 - Aug. 28	1973	12507.32	0.800				103.90	0.060
Eagle	May 19 - Aug. 31	1979	129400.00	1.510					
Dickey	June 27 - Oct. 10	1981	4962.00	1.650	0.681	0.163	319.00	3999.00	0.523
Dickey	June 26 - Oct. 10	1982	4312.00	1.040	0.778	0.185	287.00	2864.00	0.325
Dickey	June 30 - Oct. 10	1984	4277.00	1.110	0.426	0.171	274.00	2899.00	0.614
Dickey	June 28 - Oct. 10	1986	3799.00	1.230	0.999	0.155	277.00	2223.00	0.341
Drag	June 27 - Oct. 10	1981	4392.00	0.210	1.172	0.295	139.00	1974.00	0.134
Drag	June 25 - Oct. 10	1983	2377.00	0.162	1.390	0.137	95.00	895.00	0.045
Drag	June 30 - Oct. 10	1984	5088.00	0.407	0.829	0.305	206.00	2968.00	0.301
Drag	June 29 - Oct. 10	1985	2804.00	0.153	1.731	0.276	260.00	1583.00	0.102
Koshlong	June 27 - Oct. 10	1981	3380.00	0.893	1.042	0.208	163.00	2657.00	0.466
Koshlong	June 26 - Oct. 10	1982	3789.00	0.987	0.436	0.203	202.00	2386.00	0.705
Twelvemile	June 27 - Oct. 10	1981	2129.00	0.133	0.405	0.054	74.00	1344.00	0.110
Twelvemile	June 25 - Oct. 10	1983	4558.00	1.111	0.095	0.038	262.00	3506.00	0.197
Twelvemile	June 30 - Oct. 10	1984	4827.00	0.349	0.170	0.051	236.00	3249.00	0.187
Twelvemile	June 29 - Oct. 10	1985	3643.00	0.521	0.276	0.073	410.00	2854.00	0.287
Balsam	May 10 - Sept. 30	1986	117983.00	2.350	0.194	0.116	809.00	18723.00	0.410
Pigeon	May 11 - Sept. 2	1985	273935.00	5.610	0.252	0.135	163.00	11976.00	1.420
Scugog	May 12 - Sept. 2	1984	120229.00	1.430	0.178	0.096	394.00	6740.00	0.100
Rice	May 14 - Sept. 16	1983	665048.00	18.880	0.019	0.006	9295.00	665048.00	0.140
Balsam	May 13 - Oct. 15	1978	173756.00	5.600	0.170		398.75		0.980
Rice	May 12 - Oct. 30	1979	956991.00	21.800	0.150	0.150	113.00	6699.00	0.390
Scugog	May 10 - Sept. 30	1980	1224.00	1.720		0.100	272.00		
Rice	May 12 - Oct. 30	1979	16004.00	21.800		0.150	113.00		0.390
Round	May 17 - June 5	1977	5157.60	1.600			6.50	20.60	0.002
Gowganda		1972							0.704
Gowganda	May 20 - Aug. 31	1978	19397.30	3.660	0.117				
Round	May 15 - Aug. 31	1976	5169.71	1.270				12.75	0.006
Gowganda	May 20 - Aug. 31	1978	19397.00	3.659					0.743
Wendigo	May 21 - Aug. 31	1978	6483.00	3.195					1.162
Mistinikon	June - August	1977	10594.00	1.415					0.140
Baie Du Dore	June - September	1963-81			1.830	1.290	181.60		
Lake of the Woods	May 10 - Sept. 29	1977	1461097.00	1.510					
Lake of the Woods	May 21 - Sept. 30	1983	842840.00	0.920	0.020				0.040
Shoal	May - September	1982	180.00		0.280	0.250			
Lake of the Woods	May 15 - Sept. 30	1982	219950.00	0.520	0.010				0.020
Shoal	May - September	1981	77.10		0.200	0.160			
Simcoe	May 12 - Sept. 15	1979	157626.00						
Simcoe	May 1 - Sept. 15	1978	206812.00						
Simcoe	May 1 - Sept. 15	1977	180969.00						
Patterson	June 23 - Aug. 31	1975	4825.40		0.020		165.00		
Bennett	June 23 - Aug. 31	1975	11279.44		0.075	0.041			
Dalhousie	June 23 - Aug. 31	1975	8920.00			0.038			
Bennett	May 20 - Aug. 29	1977	13971.07		0.031	0.031			

... continued

Table 8. continued ...

LAKE	TIME PERIOD OF CREEL	YEAR	ALL SPECIES		SMALLMOUTH BASS				
			TOTAL EFFORT	TOTAL YIELD (kg/ha)	OBSERVED CUE (rd-hr)	OBSERVED HUE (rd-hr)	OBSERVED EFFORT (rd-hr)	ESTIMATED EFFORT (rd-hr)	YIELD (kg/ha)
Bennett		1972			0.068	0.044			
Fagan	May 28 - Aug. 29	1977	796.87		0.119	0.071			
White	May 19 - Aug. 30	1977	56588.57		0.094	0.018			
White		1974			0.046	0.035			
White		1972			0.015	0.012			
Trent River	May 11 - Aug. 15	1979	193341.70	6.170	0.460		309.32	14656.60	1.640
Bob's	June - August	1980	98866.80	3.700			276.85	35231.81	0.430
Niagara River		1974	35231.81						8.800
Old Welland Canal	June 27 - Sept. 6	1976	5432.80						0.350
McQuaby	May - August	1984	2985.00	1.405					0.260
Marten	May - August	1983	13829.00	1.049					0.080
Wickstead	May - August	1983	12756.00	1.735					0.010
Wolf (Beatty)	May - August	1984	1351.00	1.016					0.278
Ruth	May - August	1984	2260.00	0.751					0.000
Big Clear	June 4 - Sept. 8	1983	62.00	1.260	1.567	0.703	37.00		0.390
Big Rideau	June 4 - Sept. 8	1983	1902.00	1.980	0.485	0.099	404.00		0.180
Charleston	June 4 - Sept. 8	1983	3164.00	4.840	0.273	0.076	369.00		0.400
Devil	June 4 - Sept. 8	1983	1127.00	5.830	0.526	0.200	275.00		0.640
Long	June 26 - Oct. 15	1982	247.00	7.080	0.237	0.148	34.00		0.660
Opinicon	June 26 - Oct. 15	1982	1283.50	5.290	0.177	0.068	147.00		0.240
Sydenham	June 26 - Nov. 30	1982	915.80	5.670	0.243	0.118	152.00		1.060
Upper Rideau	June 26 - Oct. 15	1982	1386.40	4.480	0.229	0.035	371.00		0.240
Big Clear	June 6 - Sept. 8	1981	72.90	3.270	0.977	0.884	22.00		0.610
Big Rideau	June 6 - Sept. 8	1981	2144.50	2.730	0.342	0.051	573.00		0.160
Charleston	June 6 - Sept. 8	1981	2168.30	4.530	0.220	0.063	478.00		0.330
Devil	June 6 - Sept. 8	1981	833.90	4.600	0.325	0.202	114.00	1145.00	0.460
Basswood	May 5 - Sept. 12	1971						1334.40	0.017
Basswood	May 2 - Sept. 30	1970	8506.10	0.810					0.040
South Tilley	May 21 - Sept. 15	1983	3752.00	3.604					0.707
North Tilley	May 21 - Sept. 15	1983	1088.00	0.703					0.430
Simcoe	May 1 - Sept. 14	1975				0.110	4745.00		
Simcoe	May 27 - Aug. 14	1975				0.080	1800.00		
Simcoe	May 1 - Sept. 8	1976				0.323	1961.00	61348.50	
Simcoe	May 1 - Sept. 15	1977	180969.00			0.197	3752.25	49258.10	
Simcoe	May 12 - Sept. 15	1979	157626.00			0.107	3209.50		0.085
Lady Evelyn	May 17 - Aug 31	1980	44821.00	0.767				410.33	0.180
Herridge	June 3 - Aug. 31	1974	7935.45	1.380			20.75		0.030
Temagami		1971	63247.40	0.330				15977.00	0.020
Temagami	May 15 - Aug 29	1975	53193.10	0.220			666.75		0.040
Temagami	May 20 - Aug. 31	1978	75620.22	0.310					0.074
Bay Lake	May 15 - Sept. 6	1982	46637.00	1.362					0.056
Northern Light	May - October	1973	16547.00	0.745					0.053
Northern Light	May - September	1974	12218.00	0.549				4667.00	
Wildwood C.A.	May 12 - Sept. 3	1979	16424.00		0.120	0.085	551.00		
Fanshawe C.A.	May 10 - Sept. 1	1980	12021.00						0.005
Dog	May 16 - Aug. 31	1981	40435.00	1.260					
Long Point Bay	May 1 - Aug. 31	1983	286360.00		0.452	0.349	5038.00	168791.00	6.000
Long Point Bay	May 1 - Aug. 31	1984	224488.00		0.352	0.250	5046.00	136383.00	3.900
Long Point Bay	May 1 - Aug. 31	1985	235193.00		0.419	0.365	3741.00	131729.00	5.300
Long Point Bay	June 28 - Aug. 31	1986	215146.00		0.414	0.338	4546.00	157011.00	5.200
Long Point Bay	June 27 - Aug. 31	1987			0.442			146264.00	3.300
Nanticoke Gen. St'n	June 10 - Oct. 31	1985	8103.00		0.394	0.161	545.00	4167.00	4.250
Nanticoke Gen. St'n	May 12 - Aug. 31	1986	6786.00		0.360	0.228	325.00	1754.00	1.390
Nanticoke Gen. St'n	May 11 - Aug. 31	1987	11983.00		0.993	0.430	302.00	2209.00	3.680

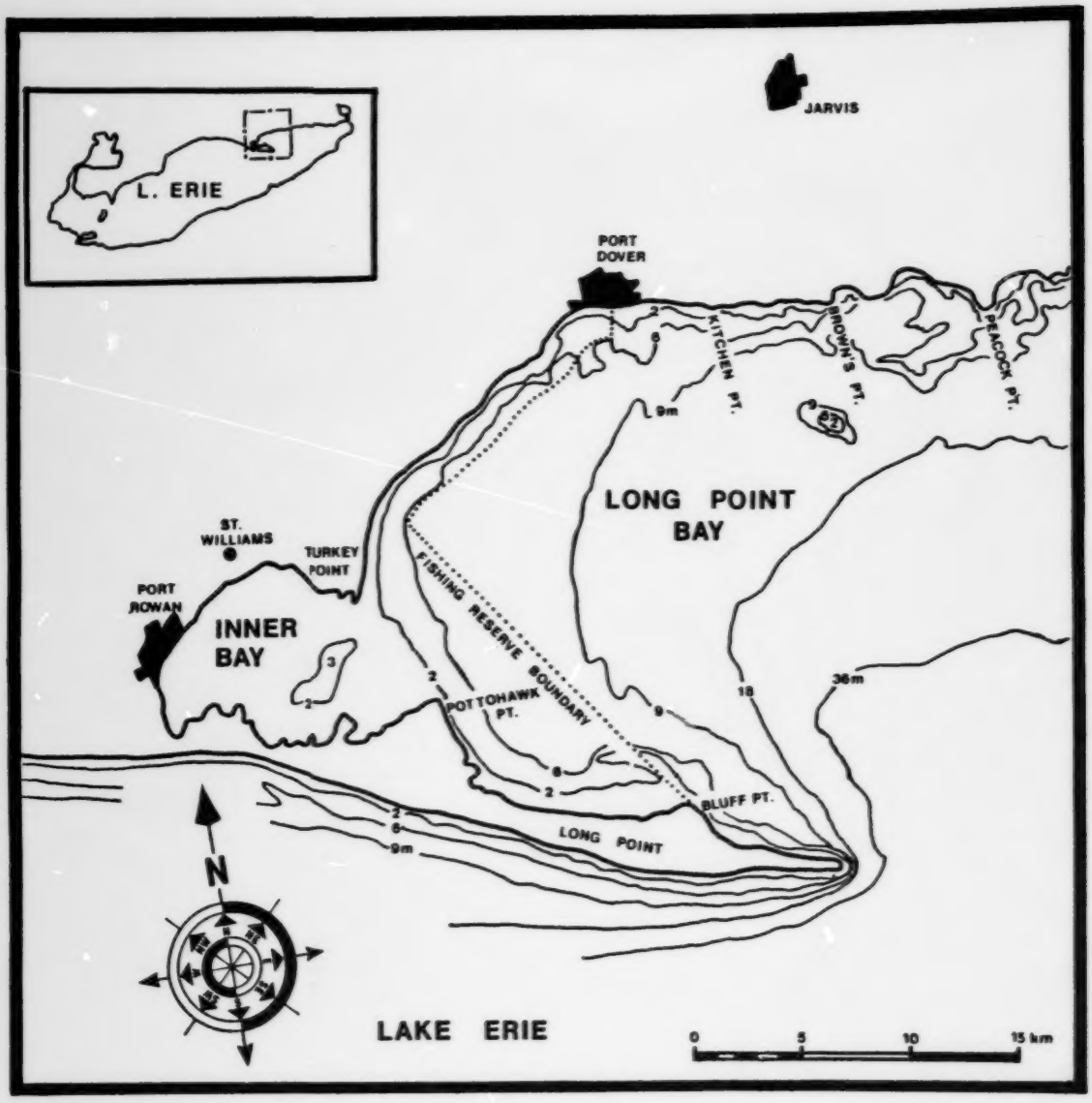


Figure 1. Long Point Bay and location of Fishing Reserve Boundary.

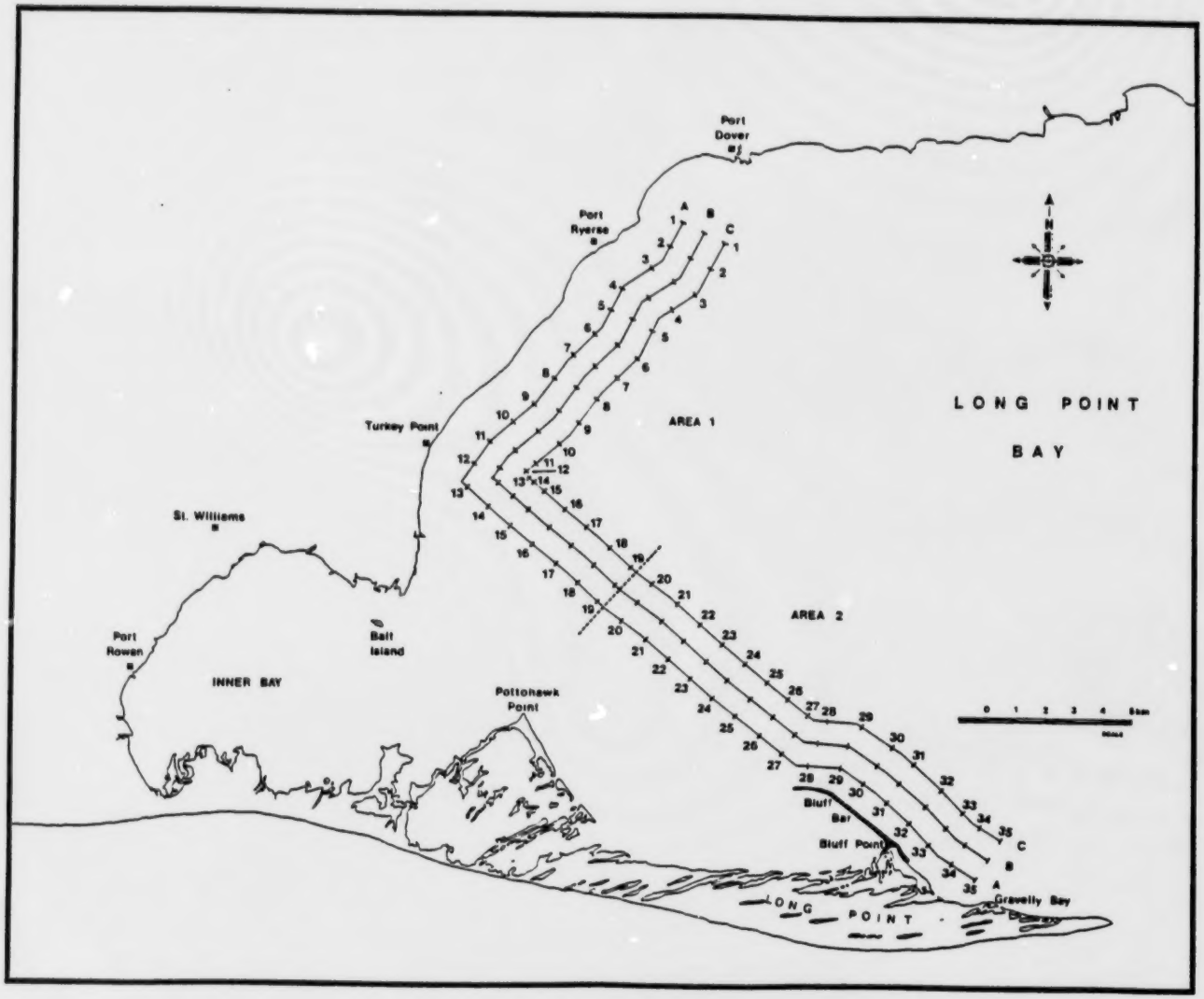


Figure 2. Sampling locations for simulated commercial fishing in 1987, Long Point Bay, Lake Erie.

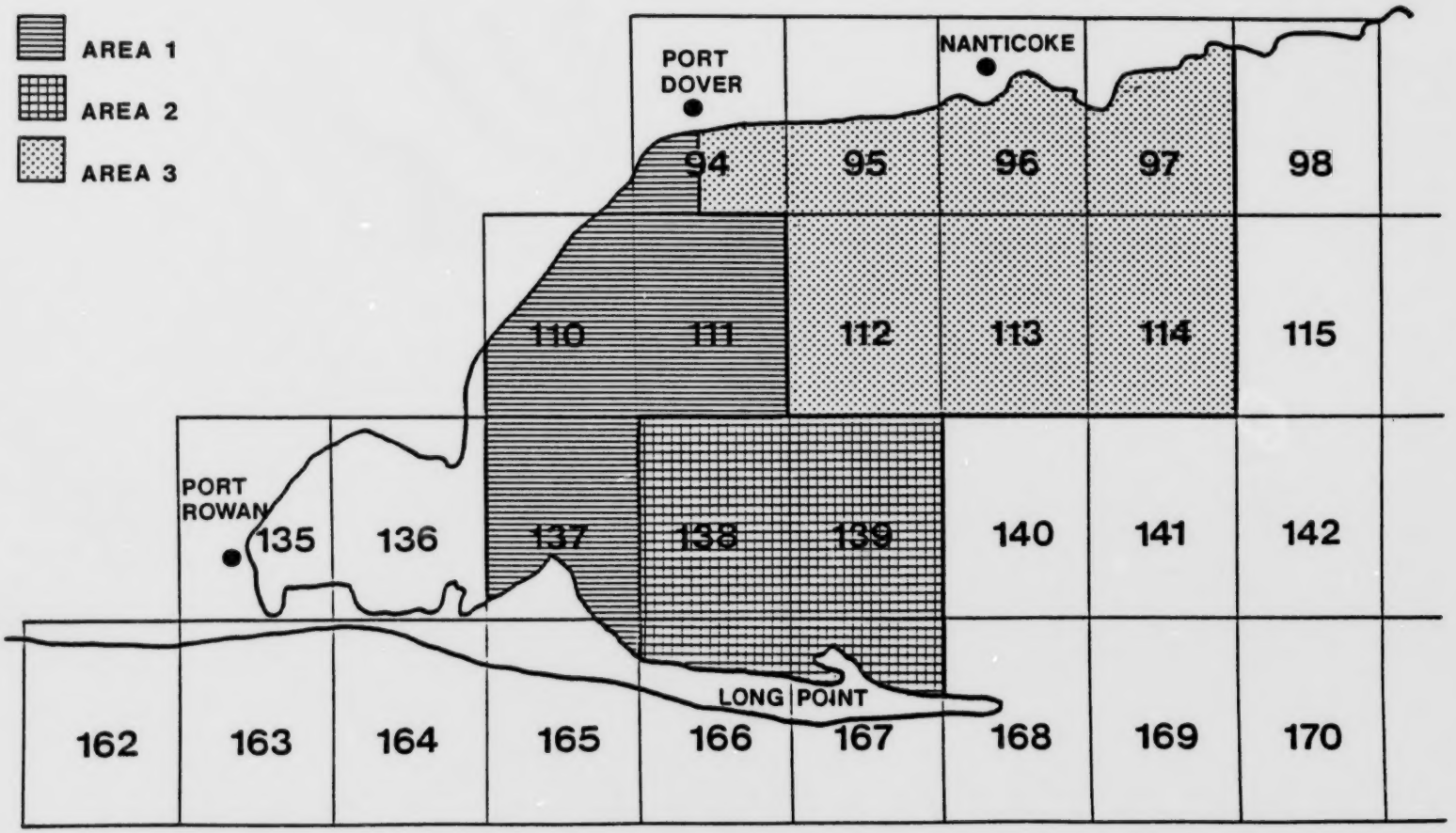


Figure 3. Commercial fishing location grids and boundaries of Areas 1, 2 and 3, Long Point Bay, Lake Erie.

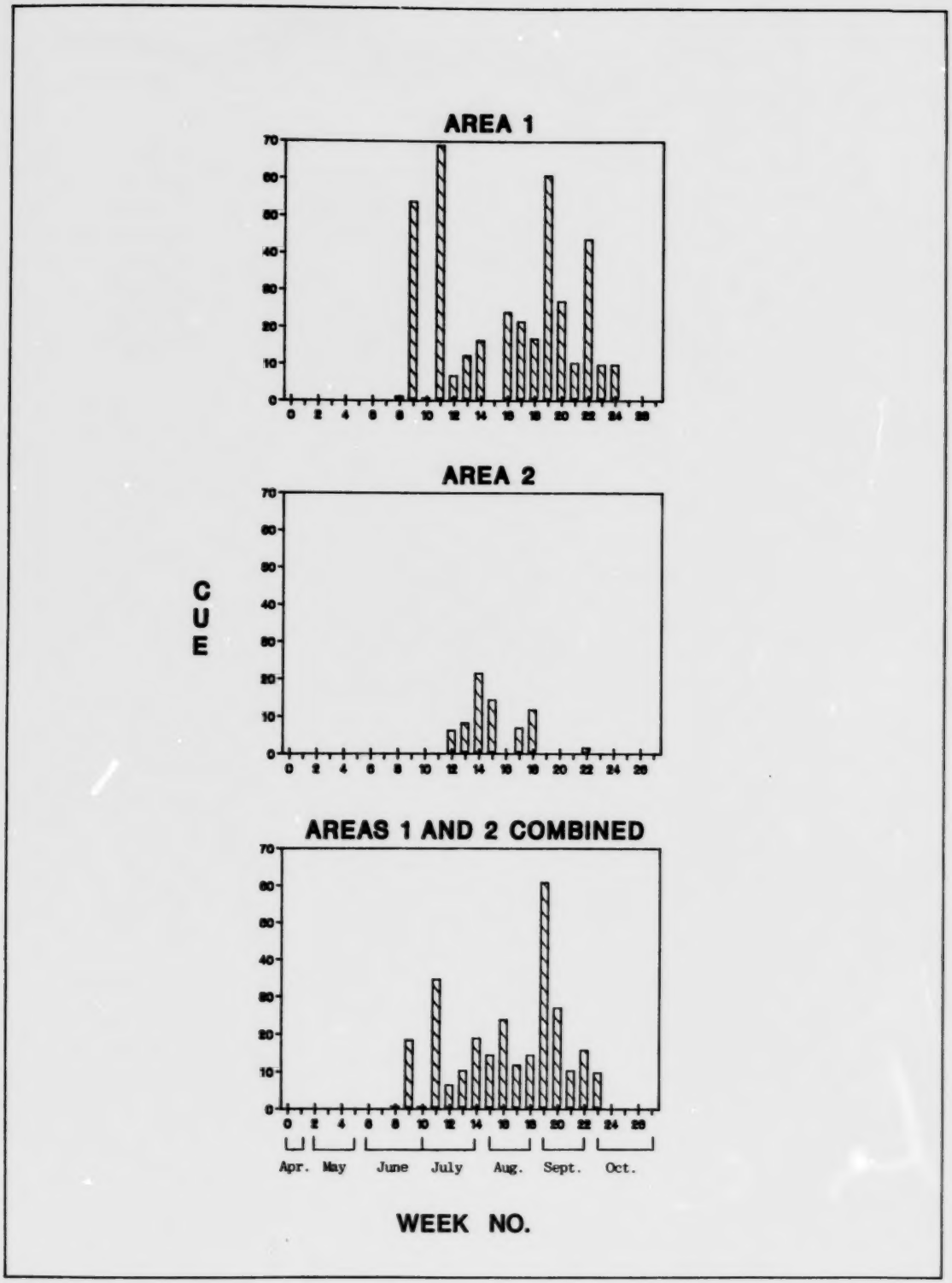


Figure 4. Weekly CUE's of smallmouth bass (fish/km) on the Fishing Reserve Boundary (Line A, Figure 2) during simulated commercial fishing, Long Point Bay, 1987.

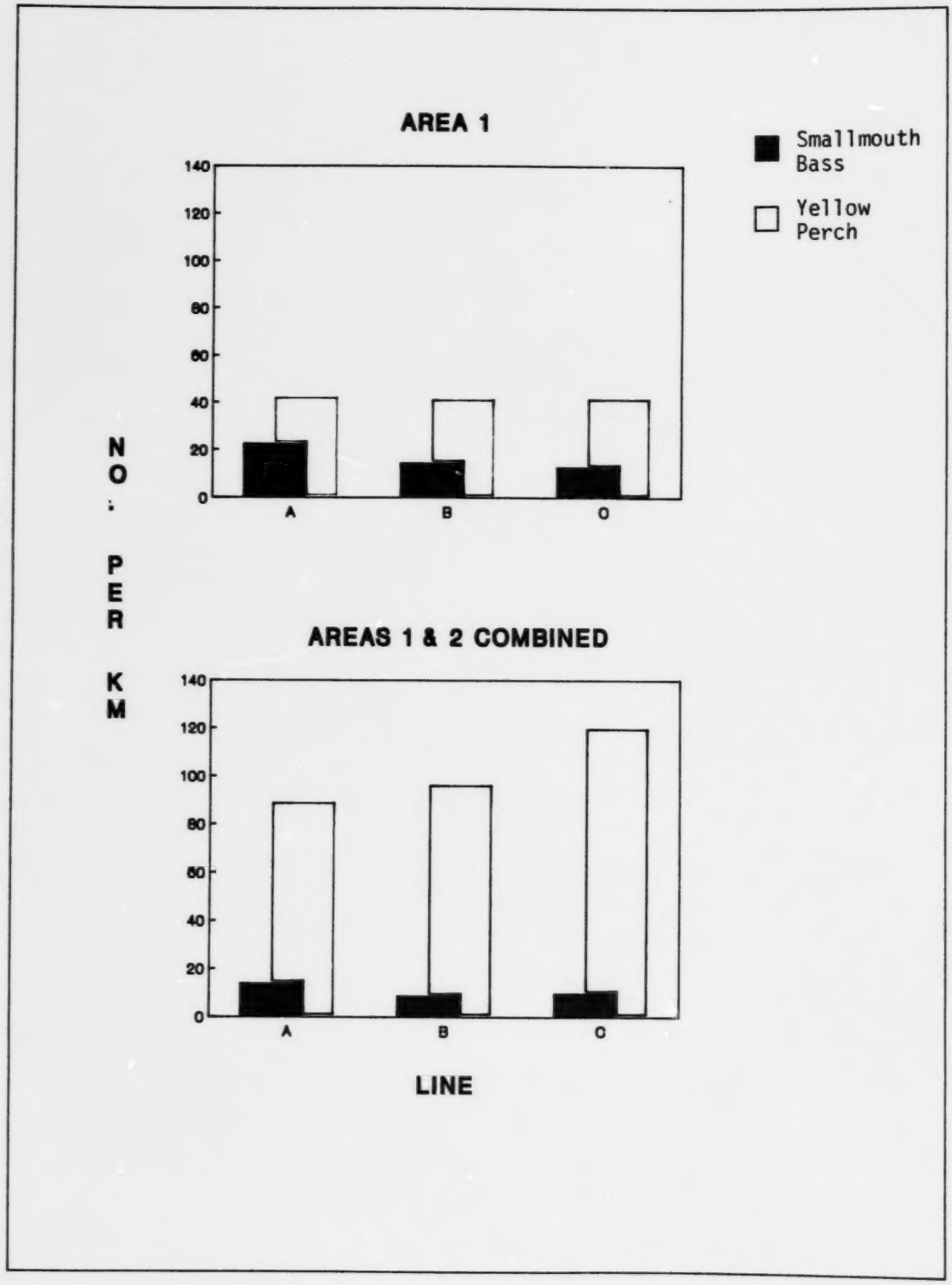


Figure 5. Comparative CUE's (fish/km) of yellow perch and smallmouth bass on Lines A, B and C (Figure 2) during simulated commercial fishing, July - September pooled, Long Point Bay, 1987.

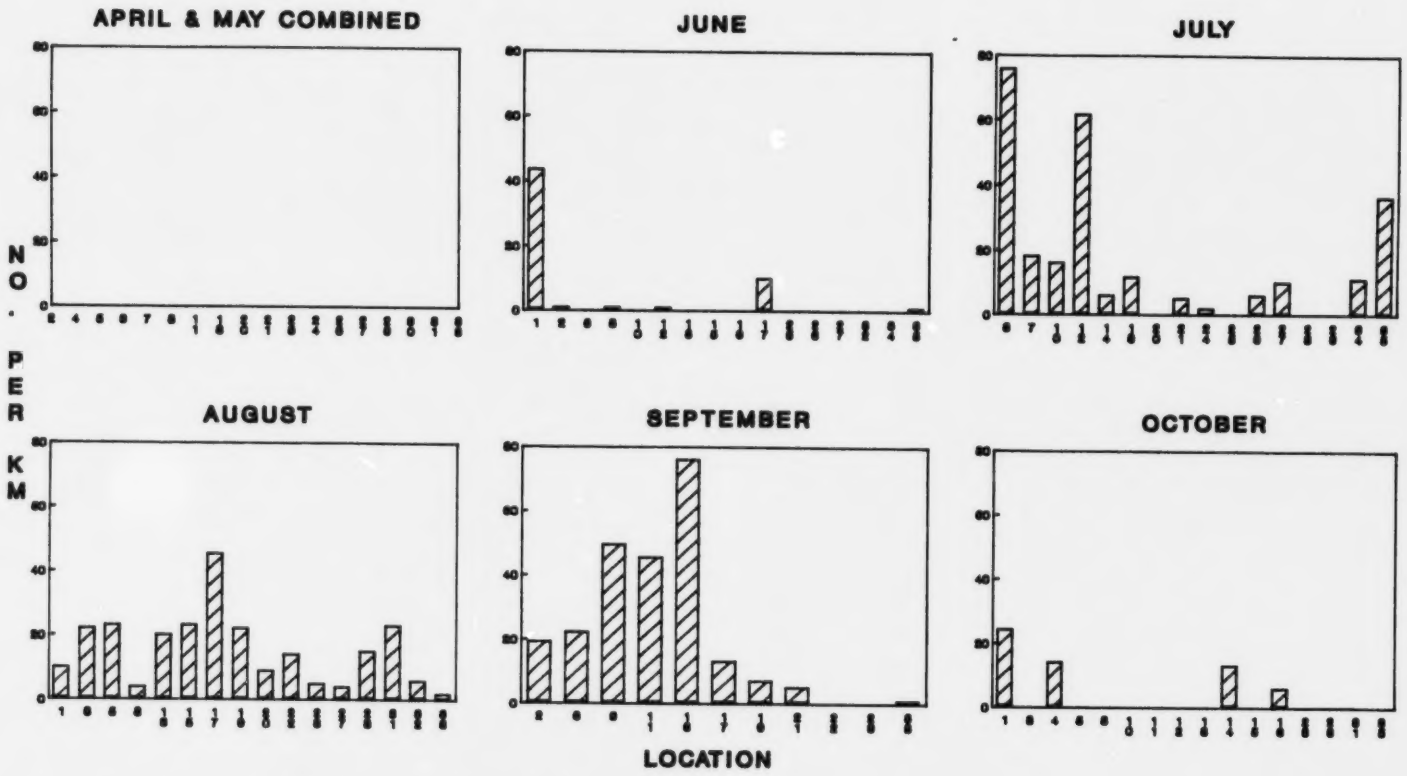


Figure 6. Comparative CUE's (fish/km) of smallmouth bass at selected locations along the Fishing Reserve Boundary (Line A, Figure 2) during simulated commercial fishing, Long Point Bay, 1987.

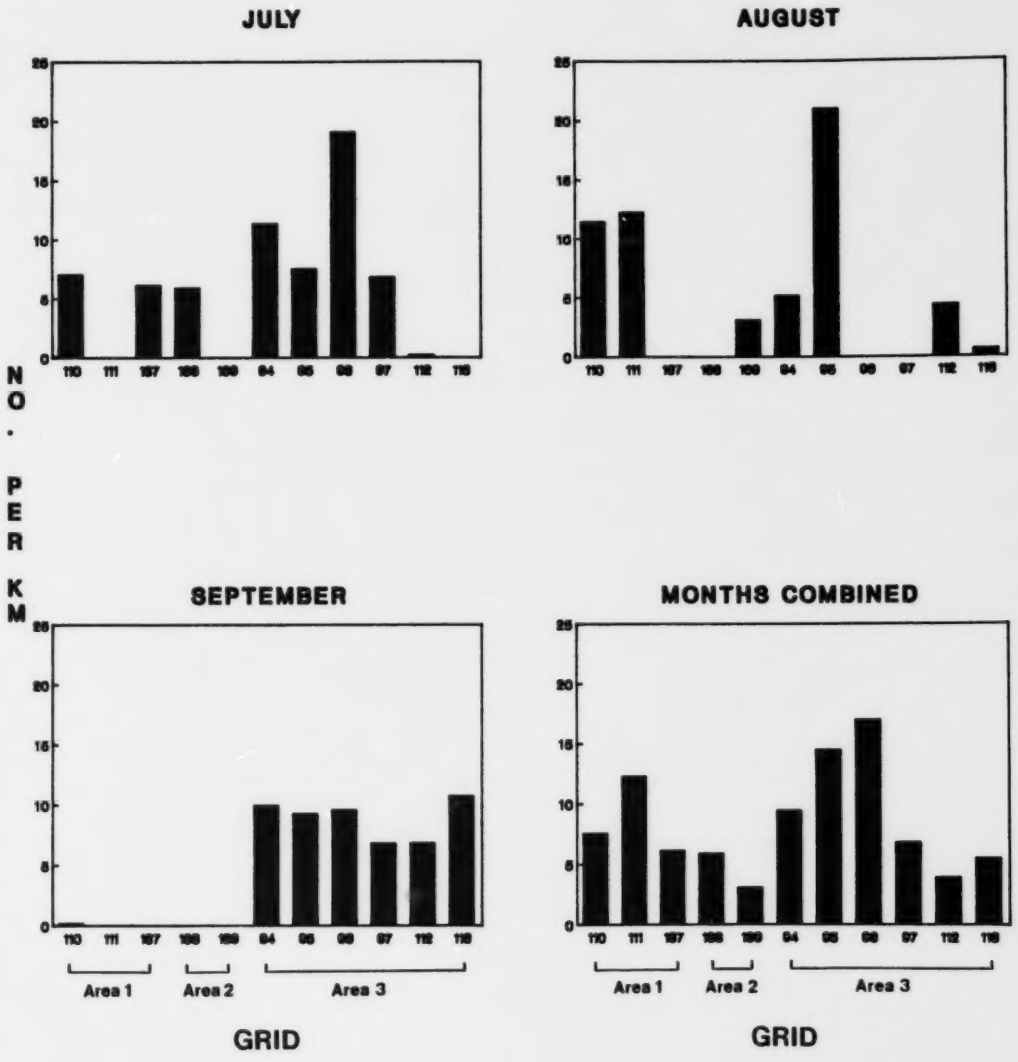


Figure 7. Comparative catches (fish/km) of smallmouth bass in commercial gill nets at various grid locations (see Figure 3) in Long Point Bay, 1987.

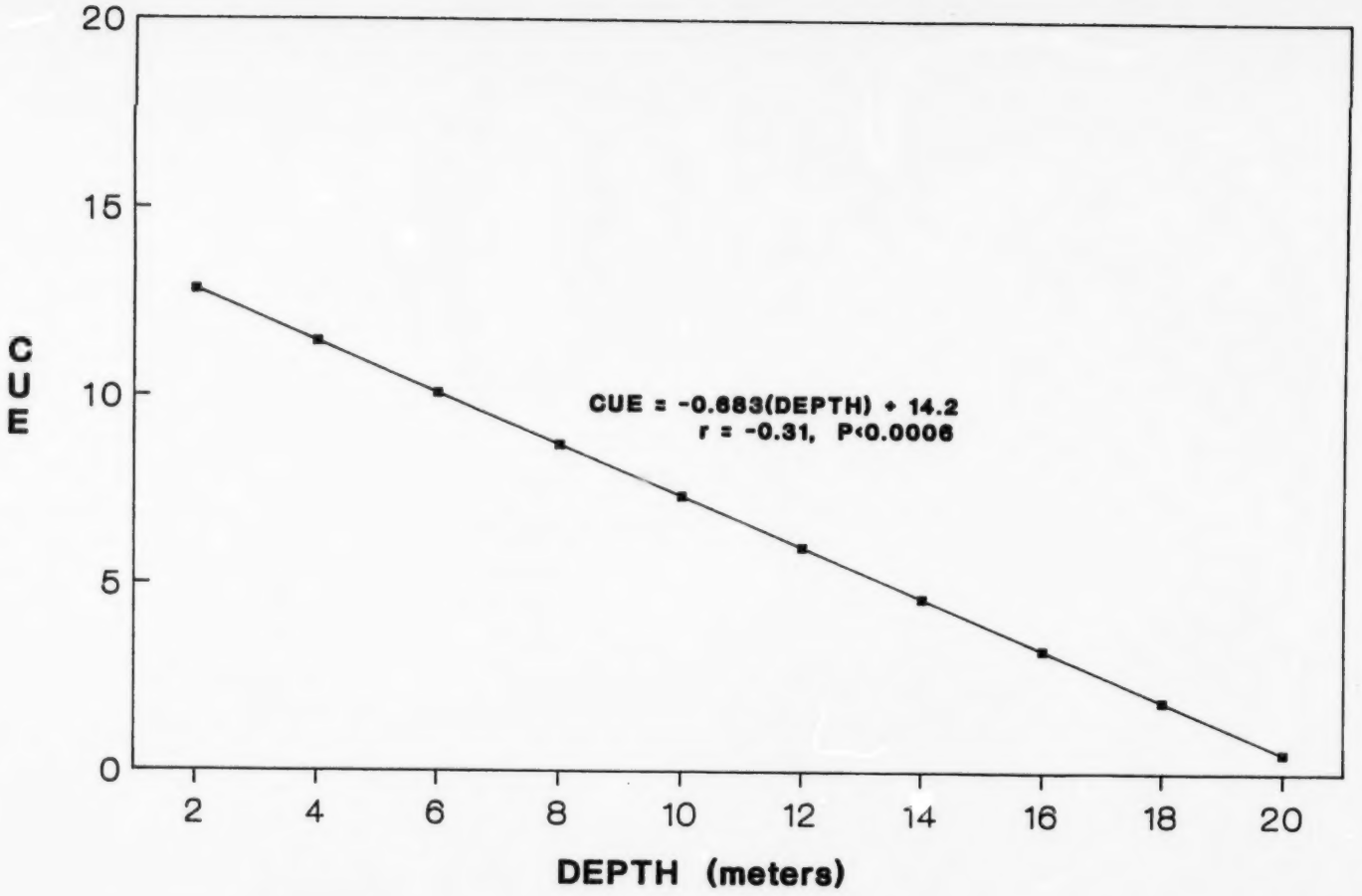


Figure 8. Predicted catches of smallmouth bass per km of commercial gill net in relation to depth of set.

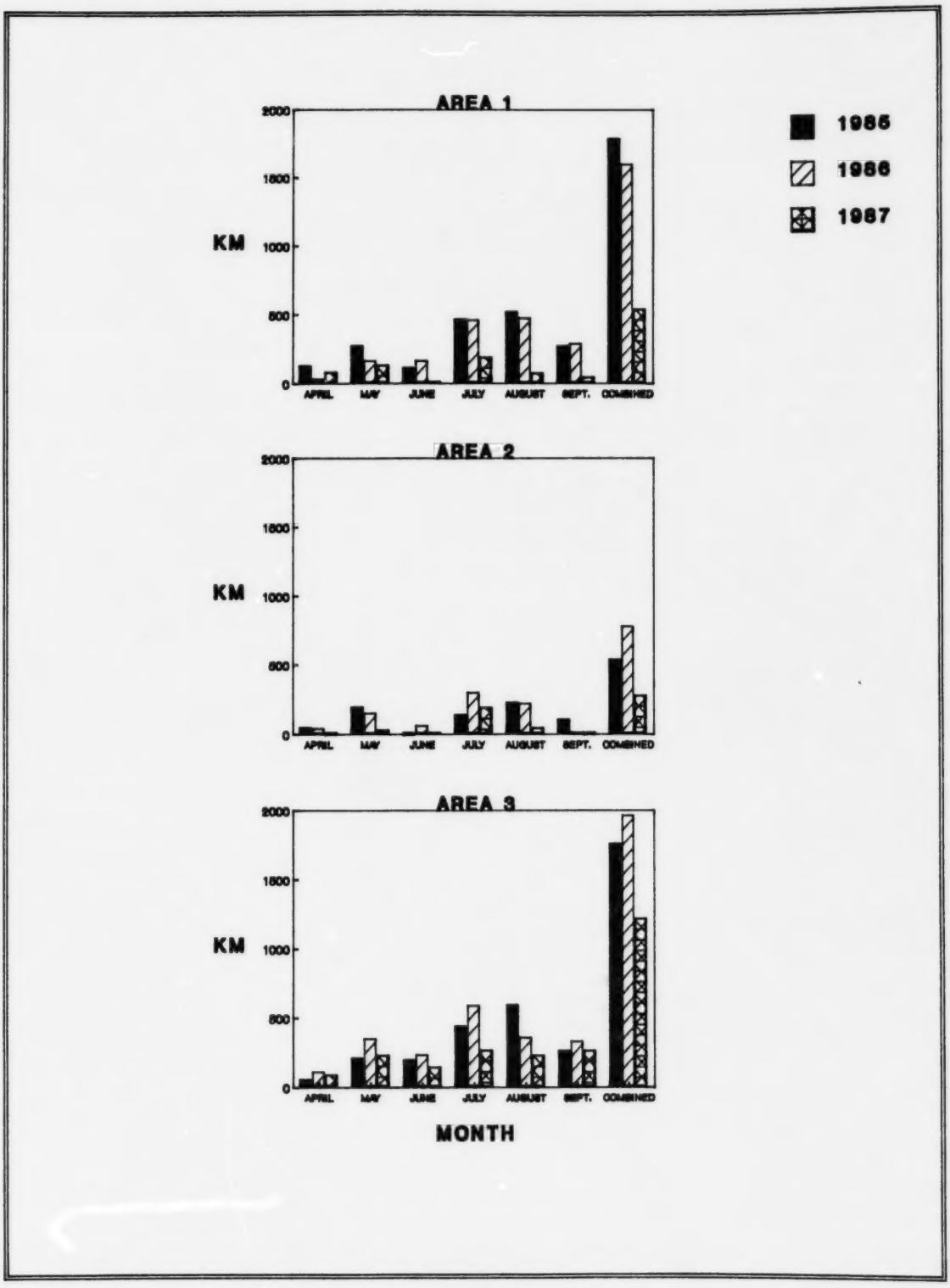


Figure 9. Annual commercial fishing effort (km of gill net) expended in various areas of Long Point Bay between 1985 and 1987.

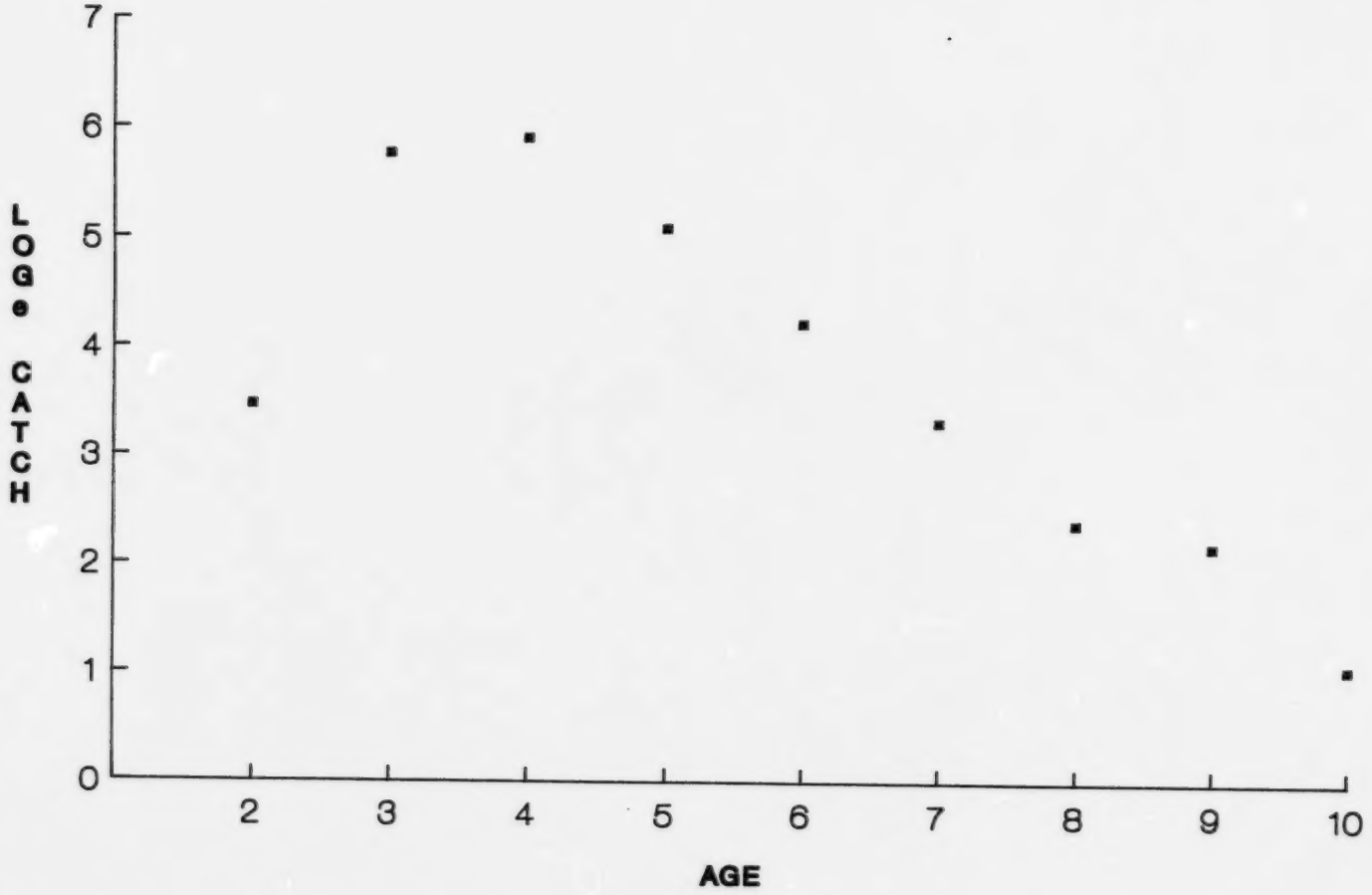


Figure 10. Catch curve for smallmouth bass in Long Point Bay. Data are derived from creel surveys carried out annually from 1979 through 1987; catches at each were determined by pooling the annual catches across all 9 years.

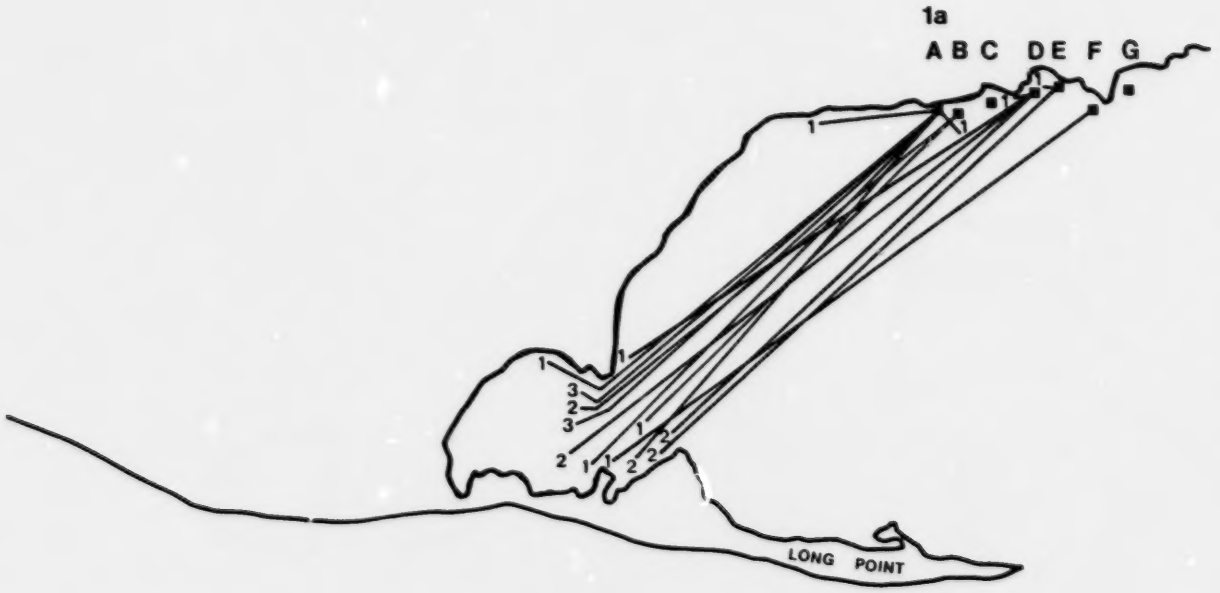


Figure 11. Smallmouth bass tag recaptures (captured and released at Nanticoke and Centre Creek trap nets), 1981-1983. Trapnet locations are represented by capital letters A to G (see Figure 3.2.5-1, MacGregor and Witzel 1987). Superscripts above trapnet locations denote the numbers of smallmouth bass recaptured and their release locations (after MacGregor and Witzel, 1987).

Appendix Table I. Gillnet effort (km), catches and CUE's of smallmouth bass and yellow perch taken by simulated commercial fishing, Long Point Bay, 1987.

LIFT DATE	LOCATION	EFFORT (km)	SMALLMOUTH BASS				YELLOW PERCH			
			Total No.	Total Wt. (kg.)	CUE No/km	CUE kg/km	Total No.	Total Wt. (kg)	CUE No/km	CUE Kg/km
April 25	A02	0.988	0	0.0	0.0	0.0	383	41.9	387.7	42.4
	B02	0.988	0	0.0	0.0	0.0	432	49.2	436.2	49.8
	C02	0.988	0	0.0	0.0	0.0	308	34.6	311.7	35.0
	A04	0.988	0	0.0	0.0	0.0	381	43.5	385.6	44.0
April 28	A18	0.988	0	0.0	0.0	0.0	113	11.9	114.4	12.0
	B18	0.988	0	0.0	0.0	0.0	98	20.4	99.2	10.5
	C18	0.988	0	0.0	0.0	0.0	161	17.5	163.0	17.7
	A20	0.988	0	0.0	0.0	0.0	299	32.7	302.6	33.1
April 30	A11	0.988	0	0.0	0.0	0.0	261	27.8	264.2	28.1
	A06	0.988	0	0.0	0.0	0.0	109	11.8	110.3	11.9
May 7	A26	0.988	0	0.0	0.0	0.0	830	94.8	840.1	95.9
	B26	0.988	0	0.0	0.0	0.0	404	46.3	408.9	46.9
	C26	0.988	0	0.0	0.0	0.0	584	64.6	591.1	65.4
	A29	0.988	0	0.0	0.0	0.0	1300	143.0	1315.8	144.7
May 8	A30	0.988	0	0.0	0.0	0.0	817	83.5	826.9	84.5
	A27	0.988	0	0.0	0.0	0.0	514	58.1	520.2	58.8
May 14	A21	0.988	0	0.0	0.0	0.0	288	30.9	291.5	31.3
	B21	0.988	0	0.0	0.0	0.0	282	29.8	285.4	30.2
	C21	0.988	0	0.0	0.0	0.0	309	33.1	312.8	33.5
	A24	0.988	0	0.0	0.0	0.0	330	37.0	334.0	37.5
May 21	A04	0.988	0	0.0	0.0	0.0	103	10.1	104.3	10.2
	B04	0.988	0	0.0	0.0	0.0	80	7.4	81.0	7.5
	C04	0.988	0	0.0	0.0	0.0	60	5.4	60.7	5.5
	A09	0.988	0	0.0	0.0	0.0	74	8.4	74.9	8.5
May 22	A33	0.988	0	0.0	0.0	0.0	131	15.8	132.6	16.0
	A30	0.988	0	0.0	0.0	0.0	174	19.2	176.1	19.4
May 26	A23	0.988	0	0.0	0.0	0.0	111	13.5	112.4	13.7
	B23	0.988	0	0.0	0.0	0.0	103	11.6	104.3	11.7
	C23	0.988	0	0.0	0.0	0.0	81	9.4	82.0	9.5
	A31	0.988	0	0.0	0.0	0.0	206	26.5	208.5	26.8
May 28	A05	0.988	0	0.0	0.0	0.0	51	4.5	51.6	4.6
	B05	0.988	0	0.0	0.0	0.0	19	2.2	19.2	2.2
	C05	0.988	0	0.0	0.0	0.0	37	3.4	37.5	3.4
	A07	0.988	0	0.0	0.0	0.0	58	6.7	58.7	6.8
June 4	A10	0.988	0	0.0	0.0	0.0	147	17.8	148.8	18.0
	B10	0.988	0	0.0	0.0	0.0	101	11.4	102.2	11.5
	C10	0.988	0	0.0	0.0	0.0	113	12.0	114.4	12.2
	A15	0.988	0	0.0	0.0	0.0	70	7.4	70.9	7.5
June 10	A25	0.988	0	0.0	0.0	0.0	136	18.1	137.7	18.3
	B25	0.988	0	0.0	0.0	0.0	158	19.3	159.9	19.5
	C25	0.988	0	0.0	0.0	0.0	126	13.9	127.5	14.0
	A27	0.988	0	0.0	0.0	0.0	120	16.4	121.5	16.6
June 11	A13	0.988	0	0.0	0.0	0.0	42	5.5	42.5	5.6
	B13	0.988	0	0.0	0.0	0.0	32	3.8	32.4	3.8
	C13	0.988	0	0.0	0.0	0.0	27	2.0	27.3	2.0
	A16	0.988	0	0.0	0.0	0.0	51	6.1	51.6	6.2
June 17	A34	0.988	0	0.0	0.0	0.0	254	32.6	257.1	33.0
	B34	0.988	0	0.0	0.0	0.0	160	20.3	161.9	20.6
	C34	0.988	0	0.0	0.0	0.0	136	15.4	137.7	15.6
	A32	0.988	0	0.0	0.0	0.0	297	38.3	300.6	38.8
June 18	A08	0.988	1	0.1	1.0	0.1	13	1.4	13 2	1.4
	B08	0.988	0	0.0	0.0	0.0	6	0.6	6.1	0.6
	C08	0.988	0	0.0	0.0	0.0	7	0.6	7.1	0.6
	A12	0.988	1	0.1	1.0	0.1	16	1.7	16.2	1.7
June 24	A17	0 988	10	1.7	10.1	1.7	48	5.2	48.6	5.2
	B17	0.988	7	3.0	7.1	3.0	57	6.9	57.7	6.9
	C17	0.988	3	0.7	3.0	0.7	97	11.1	98.2	11.2
	A01	0.988	43	5.7	43.5	5.8	148	17.0	149.8	17.2

...continued

Appendix Table I. continued ...

LIFT DATE	LOCATION	EFFORT (km)	SMALLMOUTH BASS				YELLOW PERCH			
			Total No.	TOTAL Wt. (kg)	CUE		Total No.	TOTAL Wt. (kg)	CUE	
					No/km	kg/km			No/km	Kg/km
June 25	A35	0.988	1	0.1	1.0	0.1	290	34.6	293.5	35.0
	B35	0.988	0	0.0	0.0	0.0	434	54.4	439.3	55.0
	C35	0.988	0	0.0	0.0	0.0	555	66.3	561.7	67.1
	A26	0.988	0	0.0	0.0	0.0	313	41.5	316.8	42.0
June 30	A06	0.988	0	0.0	0.0	0.0	313	34.4	316.8	34.8
	B06	0.988	0	0.0	0.0	0.0	69	7.2	69.8	70.7
	C06	0.988	0	0.0	0.0	0.0	49	5.1	49.6	5.2
	A02	0.988	1	0.1	1.0	0.1	83	9.1	84.0	9.2
July 1	A20	0.988	0	0.0	0.0	0.0	222	22.7	224.7	23.0
	B20	0.988	0	0.0	0.0	0.0	98	11.3	99.2	11.4
	C20	0.988	0	0.0	0.0	0.0	87	9.6	88.1	9.7
	A28	0.988	0	0.0	0.0	0.0	54	6.0	54.7	6.1
July 8	A03	0.988	75	9.3	75.9	9.4	63	7.1	61.8	7.1
	B03	0.988	26	4.2	26.3	4.3	28	3.3	28.3	3.3
	C03	0.988	12	2.1	12.2	2.2	37	3.9	37.5	4.0
	A12	0.988	61	9.2	61.7	9.3	73	7.4	73.9	7.4
July 9	A29	0.988	0	0.0	0.0	0.0	313	37.1	316.8	37.6
	B29	0.988	0	0.0	0.0	0.0	137	15.8	138.7	16.0
	C29	0.988	0	0.0	0.0	0.0	191	21.1	193.3	21.4
	A25	0.988	0	0.0	0.0	0.0	77	9.8	77.9	9.9
July 15	A27	0.988	10	2.2	10.1	2.3	144	17.4	145.8	17.6
	B27	0.988	2	0.3	2.0	0.3	210	26.1	212.6	26.4
	A24	0.988	2	0.4	2.0	0.4	108	12.6	109.3	12.8
July 16	A18	0.988	7	1.5	7.1	1.5	55	5.8	55.7	5.9
	B18	0.988	2	0.2	2.0	0.2	35	3.8	35.4	3.9
	C18	0.988	2	0.4	2.0	0.4	40	4.5	40.5	4.6
	14	0.988	6	0.9	6.1	0.9	66	6.7	66.8	6.8
July 21	A07	0.988	18	2.7	18.2	2.7	55	5.8	55.7	5.8
	B07	0.988	11	1.5	11.1	1.5	37	4.0	37.5	4.0
	C07	0.988	7	1.3	7.1	1.4	33	3.5	33.4	3.5
	A14	0.988	6	1.1	6.1	1.1	131	13.5	132.6	13.7
July 22	A34	0.988	11	2.1	11.1	2.1	102	10.6	103.2	10.7
	B34	0.988	6	1.1	6.1	1.1	202	23.3	204.5	23.5
	C34	0.988	2	0.4	2.0	0.4	242	27.9	244.9	28.2
	A21	0.988	5	1.2	5.1	1.2	98	11.2	99.2	11.3
July 29	A18	0.988	16	3.1	16.2	3.1	43	6.1	43.5	6.2
	B18	0.988	10	1.8	10.1	1.8	47	4.9	47.6	5.0
	C18	0.988	10	1.5	10.1	1.5	41	4.4	41.5	4.5
	A10	0.988	16	2.7	16.2	2.7	41	4.3	41.5	4.4
July 30	A26	0.988	6	1.0	6.1	1.0	28	2.9	28.3	2.9
	B26	0.988	6	1.1	6.1	1.1	42	4.5	42.5	4.5
	C26	0.988	16	2.8	16.2	2.8	49	5.3	49.6	5.4
	A35	0.988	36	6.2	36.4	6.2	128	18.1	129.6	18.3
Aug. 5	A23	0.900	5	0.9	5.1	0.9	67	6.8	67.8	6.8
	B23	0.988	6	1.4	6.1	1.4	52	5.2	52.6	5.3
	C23	0.988	11	1.8	11.1	1.8	61	5.6	61.7	5.7
	A31	0.988	23	4.5	23.3	4.6	198	22.0	200.4	22.3
Aug. 11	A03	0.988	22	3.3	22.3	3.3	46	6.6	46.6	6.7
Aug. 12	A17	0.988	45	8.7	45.6	8.8	61	6.7	61.7	6.8
	B17	0.988	24	4.2	24.3	4.3	56	6.3	56.7	6.3
	C17	0.988	24	3.9	24.3	3.9	50	5.8	50.6	5.9
Aug. 14	A08	0.988	4	6.1	4.1	0.6	29	2.8	29.4	2.8
	B08	0.988	8	1.5	8.1	1.5	25	2.8	25.3	2.8
	C08	0.988	16	2.6	16.2	2.7	35	3.5	35.4	3.5
	A15	0.988	23	4.5	23.3	4.6	60	6.4	60.7	6.5
Aug. 18	A13	0.988	20	3.2	20.2	3.2	39	4.5	39.5	4.5
	B13	0.988	11	1.7	11.1	1.8	24	2.6	24.3	2.6
	C13	0.988	21	4.1	21.3	4.1	36	4.0	36.4	4.1
	A19	0.988	22	4.0	22.3	4.0	172	18.9	174.1	19.1

...continued

Appendix Table I. continued ...

LIFT DATE	LOCATION	EFFORT (km)	SMALLMOUTH BASS				YELLOW PERCH			
			Total No.	TOTAL Wt. (kg)	CUE		Total No.	TOTAL Wt. (kg)	CUE	
					No/km	kg/km			No/km	Kg/km
Aug. 19	A32	0.988	6	0.9	6.1	0.9	128	16.3	129.6	16.5
	B32	0.988	2	0.3	2.0	0.3	457	54.9	462.6	55.6
	C32	0.988	5	0.9	5.1	0.9	750	90.8	759.1	91.9
	A28	0.988	15	2.7	15.2	2.7	56	7.4	56.7	7.5
Aug. 20	A27	0.988	4	0.6	4.1	0.6	145	18.1	146.8	18.3
	B27	0.988	2	0.4	2.0	0.4	82	10.1	83.0	10.2
	A33	0.988	2	0.4	2.0	0.4	157	19.6	158.9	19.8
Aug. 26	A01	0.988	10	1.6	10.1	1.6	29	3.3	29.4	3.3
	B01	0.988	26	3.4	26.3	3.5	76	8.2	76.9	8.3
	C01	0.988	8	1.0	8.1	1.0	87	9.8	88.1	9.9
	A05	0.988	23	3.2	23.3	3.2	82	9.0	83.0	9.1
Aug. 27	A20	0.988	9	2.0	9.1	2.0	201	20.2	203.4	20.4
	B20	0.988	6	0.9	6.1	0.9	167	16.4	169.0	16.6
	C20	0.988	6	0.9	6.1	0.9	140	13.3	141.7	13.5
	A22	0.988	14	2.8	14.2	2.9	170	16.5	172.1	16.7
Sept. 3	A11	0.988	45	6.9	45.6	7.1	36	4.5	36.4	4.6
	A16	0.988	75	13.5	75.9	13.7	46	5.5	46.6	5.6
Sept. 9	A06	0.988	22	3.4	22.3	3.4	18	1.8	18.2	1.8
	C06	0.988	12	2.1	12.2	2.1	6	0.6	6.1	0.6
	A09	0.988	31	4.9	31.4	5.0	23	2.6	23.3	2.6
Sept. 16	A19	0.988	7	1.7	7.1	1.7	23	3.1	23.3	3.1
	B19	0.988	13	2.3	13.2	2.3	56	6.5	56.7	6.6
	A17	0.988	13	3.0	13.2	3.0	21	2.2	21.3	2.2
Sept. 22	A33	0.988	1	0.2	1.0	0.2	87	14.5	88.1	14.7
	B33	0.988	0	0.0	0.0	0.0	93	11.7	94.1	11.8
	A29	0.988	0	0.0	0.0	0.0	22	3.6	22.3	3.6
Sept. 23	A21	0.988	5	1.1	5.1	1.1	30	4.7	30.4	4.7
	B21	0.988	5	0.8	5.1	0.8	41	4.6	41.5	4.7
	A22	0.988	0	0.0	0.0	0.0	79	8.8	80.0	8.9
Sept. 24	A02	0.988	19	2.7	19.2	2.8	36	4.6	36.4	4.7
	B02	0.988	11	1.9	11.1	1.9	18	1.9	18.2	1.9
	A09	0.988	67	10.5	67.8	10.6	26	3.2	26.3	3.2
Oct. 1	A16	0.988	6	1.5	6.1	1.6	59	8.9	59.7	9.0
	C16	0.988	11	2.3	11.1	2.4	23	3.0	23.3	3.0
	A14	0.988	13	2.4	13.2	2.4	11	1.4	11.1	1.4
Oct. 7	A01	0.988	24	3.8	24.3	3.9	66	8.5	66.8	8.6
	B01	0.988	34	5.1	34.4	5.1	62	7.5	62.8	7.6
	A04	0.988	14	2.2	14.2	2.2	65	7.7	65.8	7.8
Oct. 8	A13	0.988	0	0.0	0.0	0.0	105	11.4	106.3	11.5
	C13	0.988	0	0.0	0.0	0.0	97	11.7	98.2	11.8
	A10	0.988	0	0.0	0.0	0.0	45	6.4	45.6	6.5
Oct. 14	A31	0.988	0	0.0	0.0	0.0	61	6.9	61.7	7.0
	B31	0.988	0	0.0	0.0	0.0	168	19.8	170.0	20.0
	A35	0.988	0	0.0	0.0	0.0	84	10.8	85.0	10.9
Oct. 15	A23	0.988	0	0.0	0.0	0.0	496	65.5	502.0	66.3
	C23	0.988	0	0.0	0.0	0.0	337	42.7	341.1	43.2
	A26	0.988	0	0.0	0.0	0.0	113	13.1	114.4	13.3
Oct. 16	A03	0.988	0	0.0	0.0	0.0	16	1.8	16.2	1.8
	B03	0.988	0	0.0	0.0	0.0	9	1.0	9.1	1.0
	A05	0.988	0	0.0	0.0	0.0	32	4.1	32.4	4.2
Oct. 20	A11	0.988	0	0.0	0.0	0.0	13	1.5	13.2	1.5
	B11	0.988	0	0.0	0.0	0.0	20	2.6	20.2	2.6
	A08	0.988	0	0.0	0.0	0.0	19	2.3	19.2	2.3

...continued

Appendix Table I. continued ...

LIFT DATE	LOCATION	EFFORT (km)	SMALLMOUTH BASS Total No.	SMALLMOUTH BASS TOTAL Wt. (kg)	SMALLMOUTH BASS CUE No/km	SMALLMOUTH BASS CUE Kg/km	YELLOW PERCH Total No.	YELLOW PERCH TOTAL Wt. (kg)	YELLOW PERCH CUE No/km	YELLOW PERCH CUE Kg/km
Oct. 23	A07	0.988	0	0.0	0.0	0.0	4	0.5	4.0	0.5
	B07	0.988	0	0.0	0.0	0.0	10	1.4	10.1	1.4
	A02	0.988	0	0.0	0.0	0.0	18	2.2	18.2	2.2
Oct. 29	A12	0.988	0	0.0	0.0	0.0	6	0.8	6.1	0.8
	C12	0.988	0	0.0	0.0	0.0	3	0.3	3.0	0.3
	A15	0.988	0	0.0	0.0	0.0	2	0.2	2.0	0.2
POOLED LOCS. (Apr.-Oct)	A	98.800	921	158.6	9.3	1.6	13977	1483.3	141.5	15.0
	B	40.508	218	37.1	5.4	0.9	4686	541.3	115.7	13.4
	C	34.580	166	28.8	4.8	0.8	4995	565.7	144.4	16.4
	ALL	173.888	1305	224.5	7.5	1.3	23658	2590.3	136.1	14.9
POOLED LOCS. (July-Sept)	A	45.448	528	94.3	11.6	2.1	3659	421.8	80.5	9.3
	B	20.748	153	24.8	7.4	1.2	1909	219.8	92.0	10.5
	C	15.808	140	23.7	8.9	1.5	1879	213.0	118.9	13.5
	ALL	82.004	821	142.8	10.0	1.7	7447	854.6	90.8	10.4

APPENDIX TABLE II. SAMPLE CALCULATIONS

A. Estimated catches for July 1 - September 30, areas combined, using 1987 effort levels.

1. CUE of smallmouth bass, $\hat{R} = 8.751$

2. Total reported commercial effort, areas combined = 1304.3 km

3. Estimated smallmouth bass catch, areas combined
   = 8.751 x 1304.3
   = 11,413.9

4. Std. Error of estimated catch $S(\hat{Y}_R) = N \sqrt{\frac{\Sigma(y_i - \hat{R}x_i)^2}{n(n-1)}} \cdot \sqrt{1 - \emptyset}$

   where: N = number of reported fishing occasions between July 1 and September 30
   = 381

   n = number of samples
   = 49

   $\emptyset$ = sampling fraction = n/N = 49/381

   y_i = smallmouth bass catch from i^{th} samples

   x_i = effort expended in i^{th} samples

   $S(\hat{Y}_R) = 381 \sqrt{(65486.62/2352)} \cdot \sqrt{1 - (49/381)}$
   = 381(5.2766)(0.9335)
   = 1876.69

5. 95% confidence limits on pooled estimated catch (assume Z)
   = 1876.69 x 1.96
   = 3678.3

6. Pooled estimated smallmouth bass catch = 11,414 ± 3678 bass

.... continued

B. Estimated Population Size using 1987 Commercial Effort Levels and Assuming 100% Mortality Due to Entanglement.

Given:

(1) that the average annual kill by anglers was 55,030 bass per year, and was distributed by age as follows:

AGE	KILL
2	1,761
3	17,445
≥4	35,824

(2) that the average bass kill in commercial gill nets was 11,414 bass and was distributed by age as:

AGE	KILL
2	5,935
3	5,479

(3) that the number of age 4 bass = 52,756 (see Section 3.7B.)

(4) that the number of age 4 and older bass (age ≥ 4) = 97,334 (see Section 3.7B.)

(5) that M = 0.31, F_{tot} = 0.48 and Z = 0.79 (see Section 3.7A.)

Then: (1) The number of age 3 bass (N_3) is:

$$C^3_{tot} = C^3_{anglers} + C^3_{gillnets} = 17,445 + 5,479 = 22,924$$

$$\frac{C^3_{tot}}{N_4} = 0.435 = (e^{F^3_{tot} + M}) \cdot \left(\frac{F^3_{tot}}{F^3_{tot} + M/4}\right) \cdot \left(1 - e^{-(F^n_{tot} - M/4)}\right)$$

By iteration, the value for F^3_{tot} that yields 0.435 was found to be F^3_{tot} = 0.286.

Therefore:

$$N_3 = C^3_{tot} \cdot \left(\frac{F^3_{tot} + M/4}{F^3_{tot}}\right) \cdot \left(\frac{1}{1 - e^{-(F^3_{tot} - M/4)}}\right)$$

$$= 22,924\ (1.273)\ (3.278)$$

$$= 95,645$$

... continued

(2) Similarly, the number of age 2 bass was:

$$C^2_{tot} = 1,761 + 5,935 = 7,696$$

$$\frac{C^2_{tot}}{N_3} = 0.08$$

By iteration, $F^2_{tot} = 0.059$

Therefore: $N_2 = 7,696 \div [(0.431)(0.128)] = 139,501$

C. Reconstructed Bass Population, Using 1987 Effort Levels, 100% Mortality Due to Entanglement and Reducing $F_{gillnet}$ to Zero.

This procedure is simply a matter of calculating the gill net and angler component of fishing mortality (F^n_{tot}) and subsequently eliminating the gillnet component of F^n_{tot}. For the 1987 scenario the calculations are as follows:

(a) For Age 3

(1) $F^3_{tot} = 0.286$

(2) $F^3_{angling} + F^3_{gillnet} = 0.286$

(3) $\frac{F^3_{gillnet}}{F^3_{angling}} = 0.314$ or $F^3_{angling} = \frac{F^3_{gillnet}}{0.314}$

Substituting (3) in (2):

$$F^3_{gillnet} + \frac{F^3_{gillnet}}{0.314} = 0.286$$

$\therefore F^3_{gillnet} = 0.068$

$\therefore F^3_{angling} = 0.286 - 0.068$
$= 0.218$

(b) Similarly, for Age 2: $F_{angling} = 0.013$

... continued

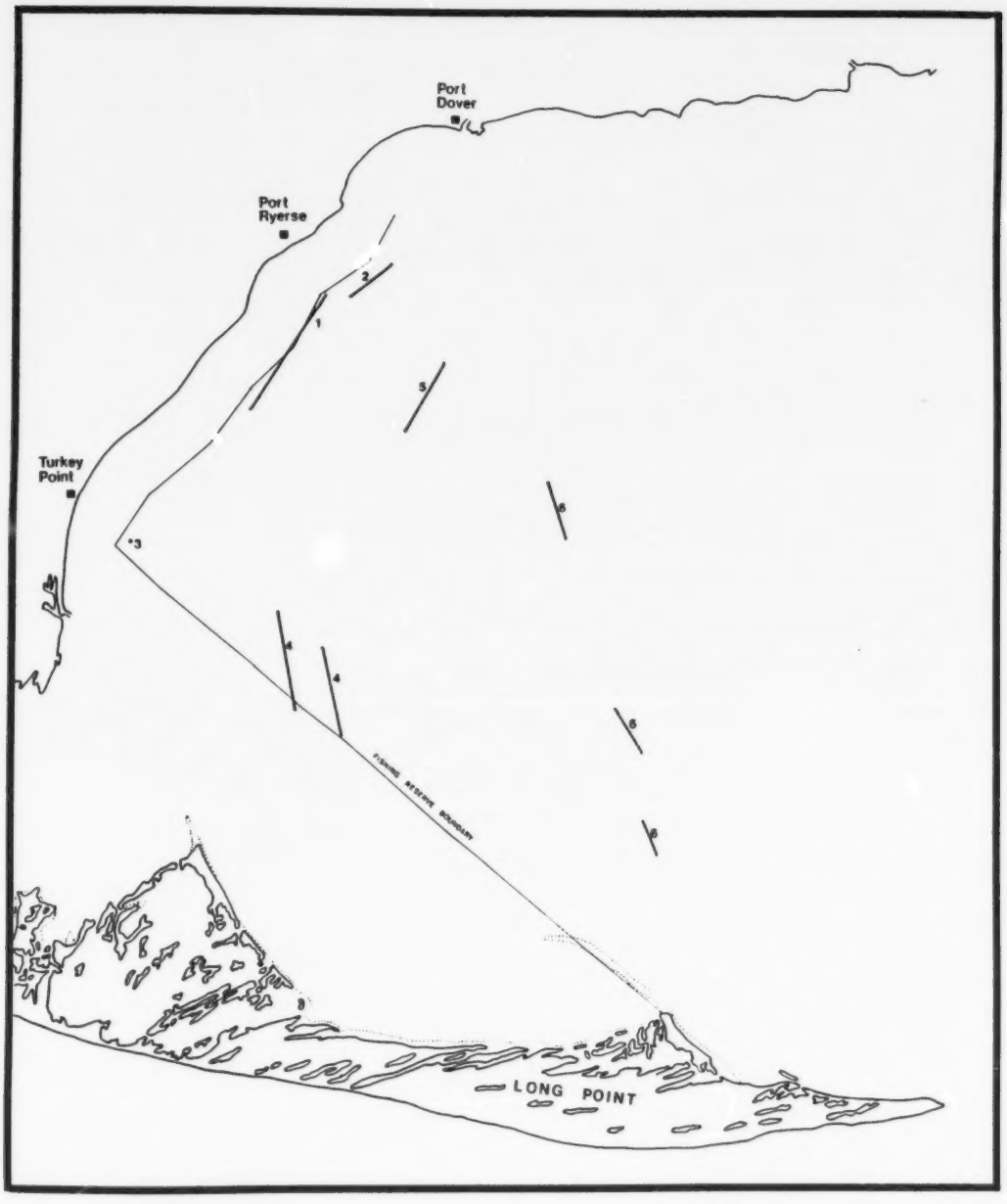
(c) Reconstruct the bass population with incidental kills reduced to zero as follows:

Given: $M = 0.31$, Z for ages 4 and older $= 0.78$,
Z for ages 2 and 3 $= M + F^{n}_{angling}$ and $S = e^{-Z}$

And recall that: $N_{\geq 4} = 1.846 \times N_4$ (See Section 3.7B)

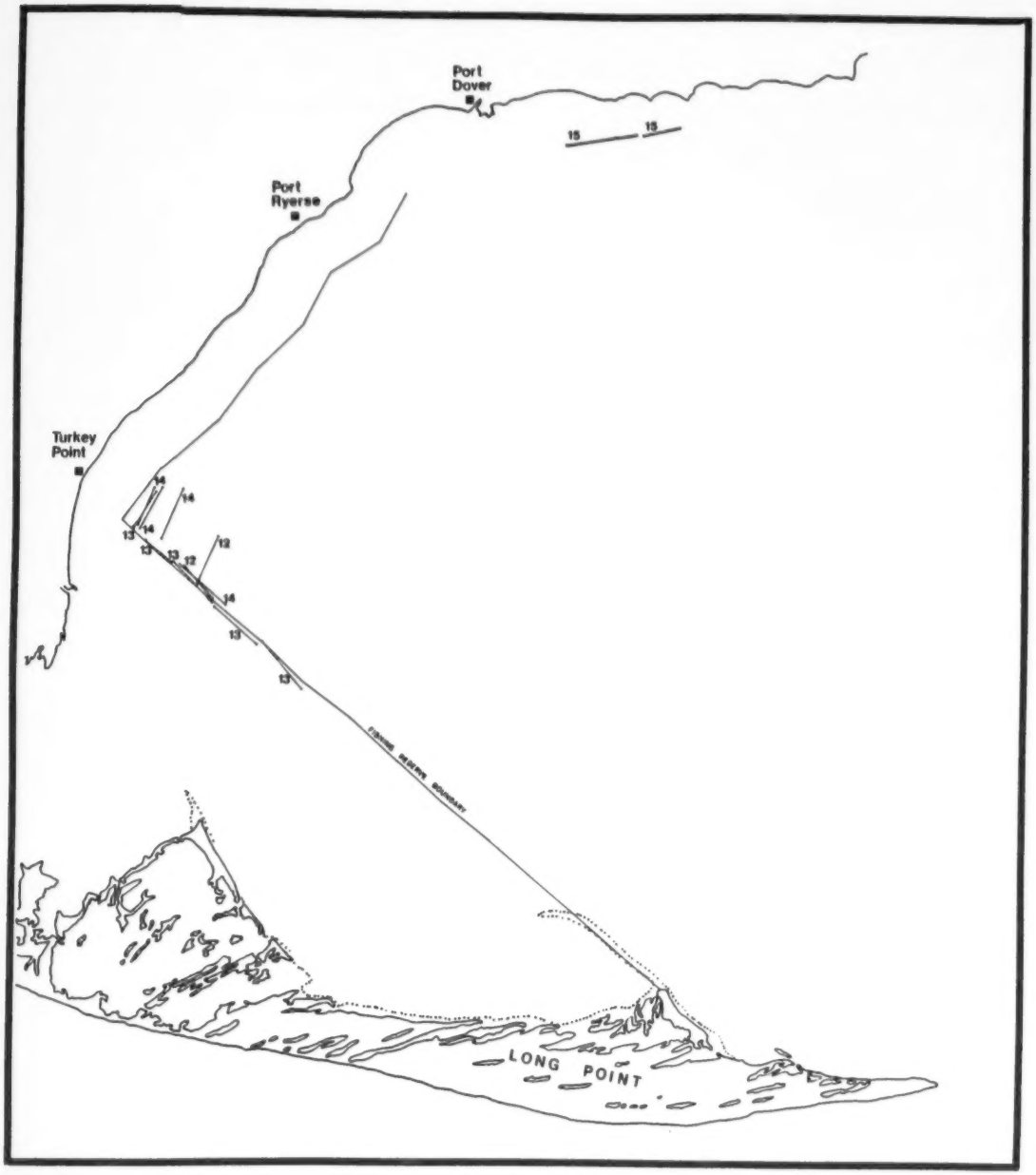
Then:

AGE	NUMBER AT START OF FISHING SEASON	Z	S
2	139,501	0.31 + 0.013 = 0.323	0.724
3	100,999	0.31 + 0.218 = 0.528	0.590
4	59,589	0.780	
≥4	109,942		



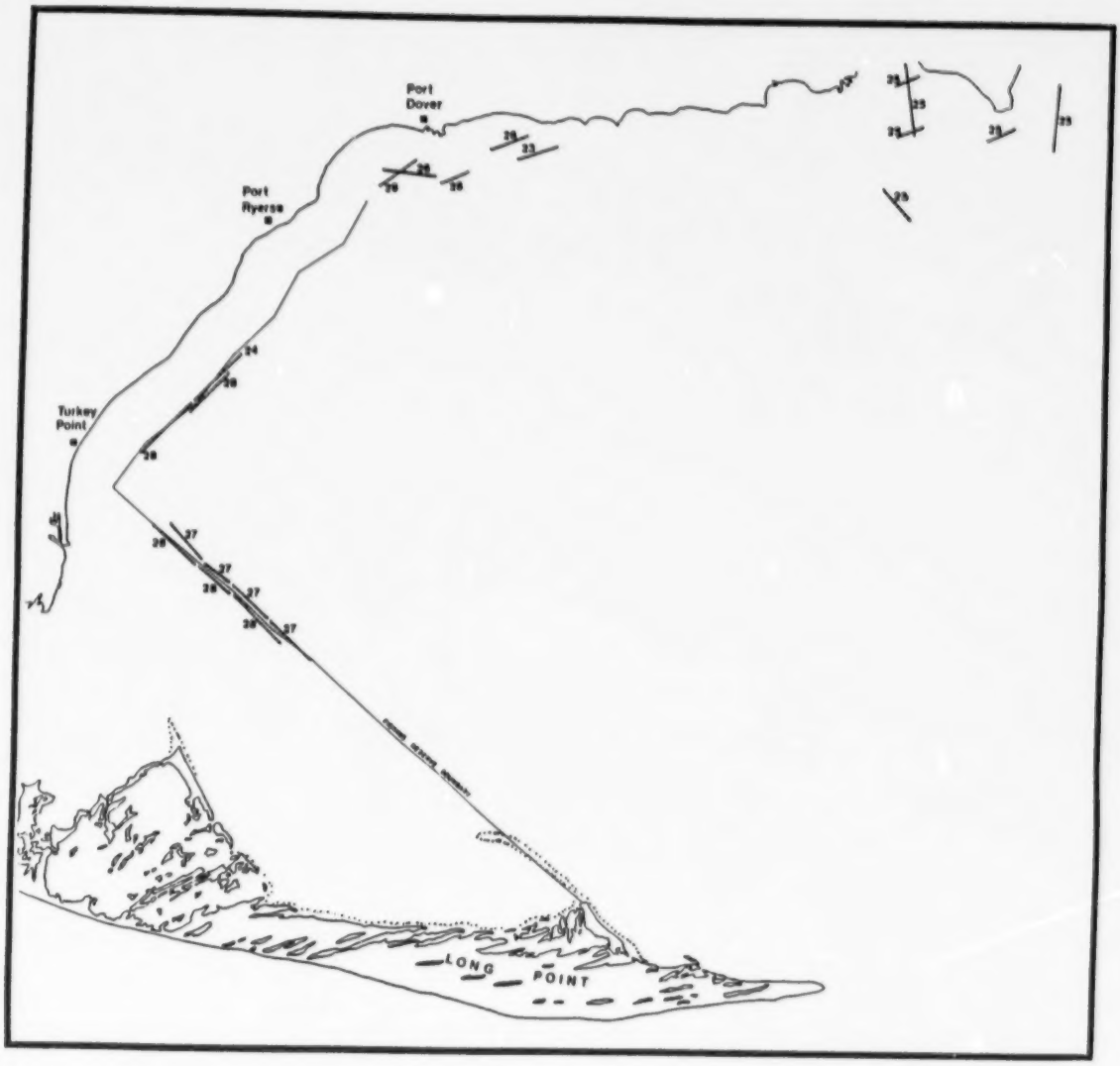
Appendix Figure I. Locations of commercial gillnet straps examined by OMNR staff between May 6 and May 28 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3. Single points denote location(s) of strap(s) where LORAN-C was not functioning.

Appendix Figure II. Locations of commercial gillnet straps examined by OMNR staff between July 1 and July 10 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.

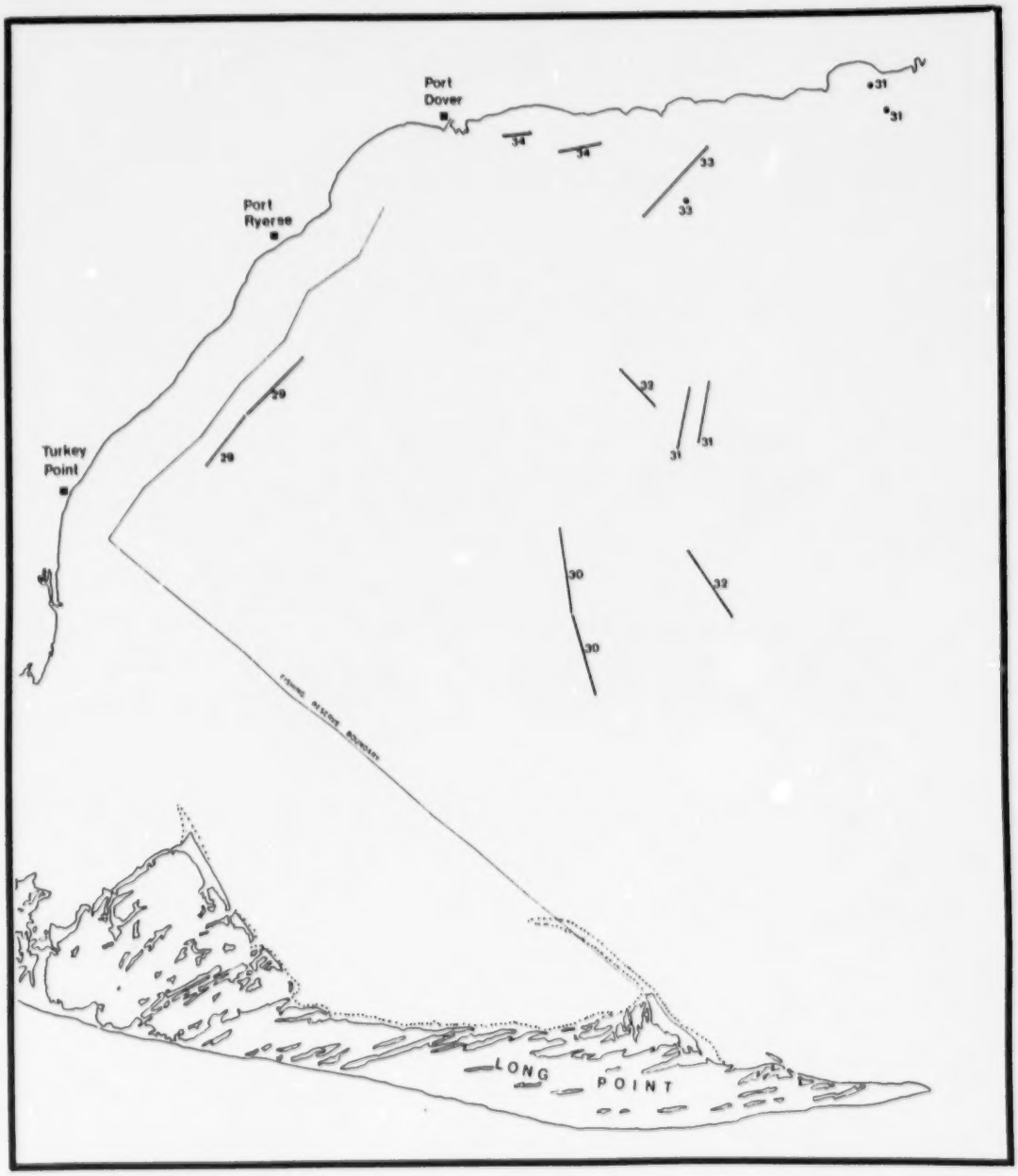


Appendix Figure III. Locations of commercial gillnet straps examined by OMNR staff between July 14 and July 17 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.

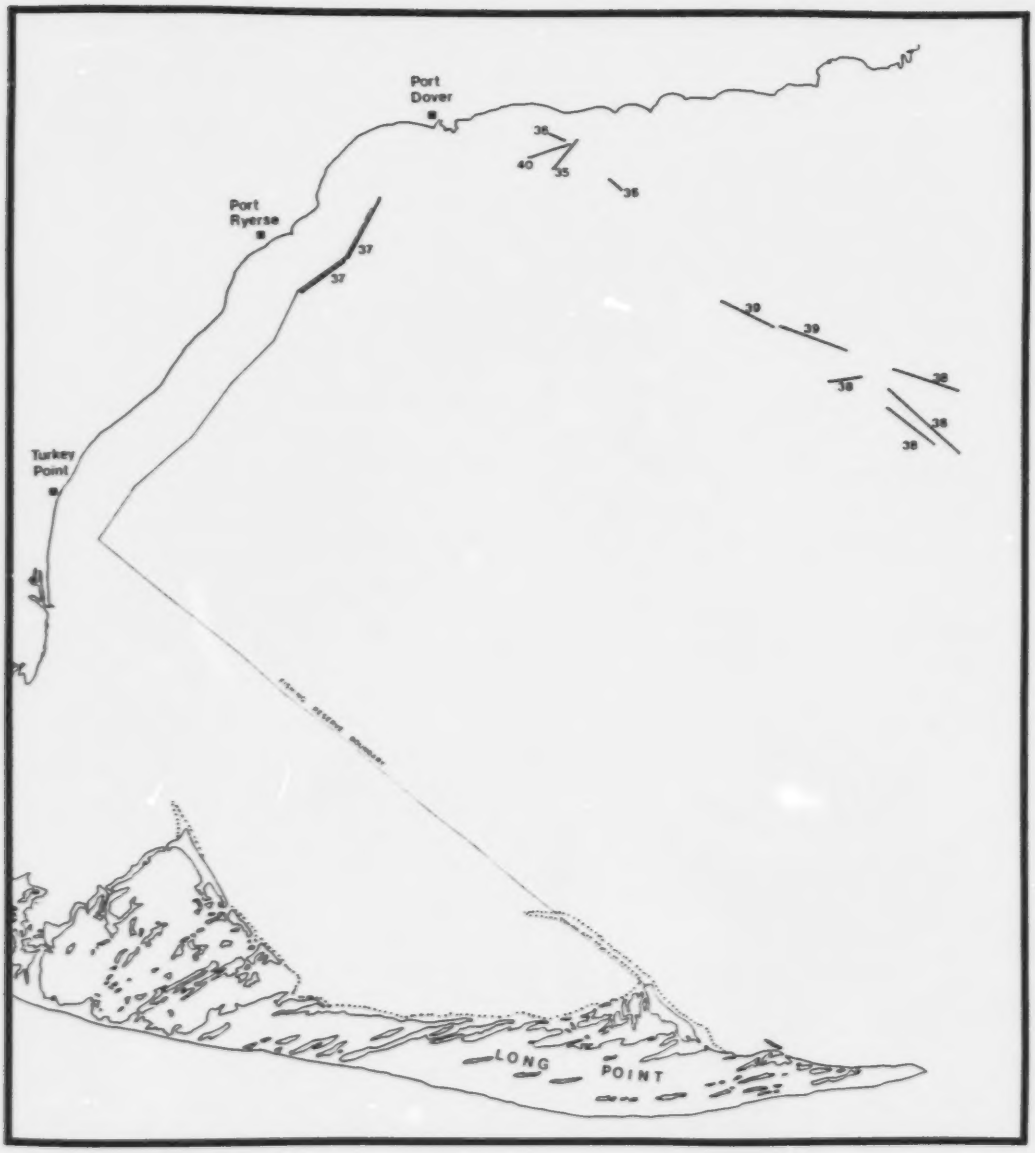
Appendix Figure IV. Locations of commercial gillnet straps examined by OMNR staff between July 20 and July 24 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.



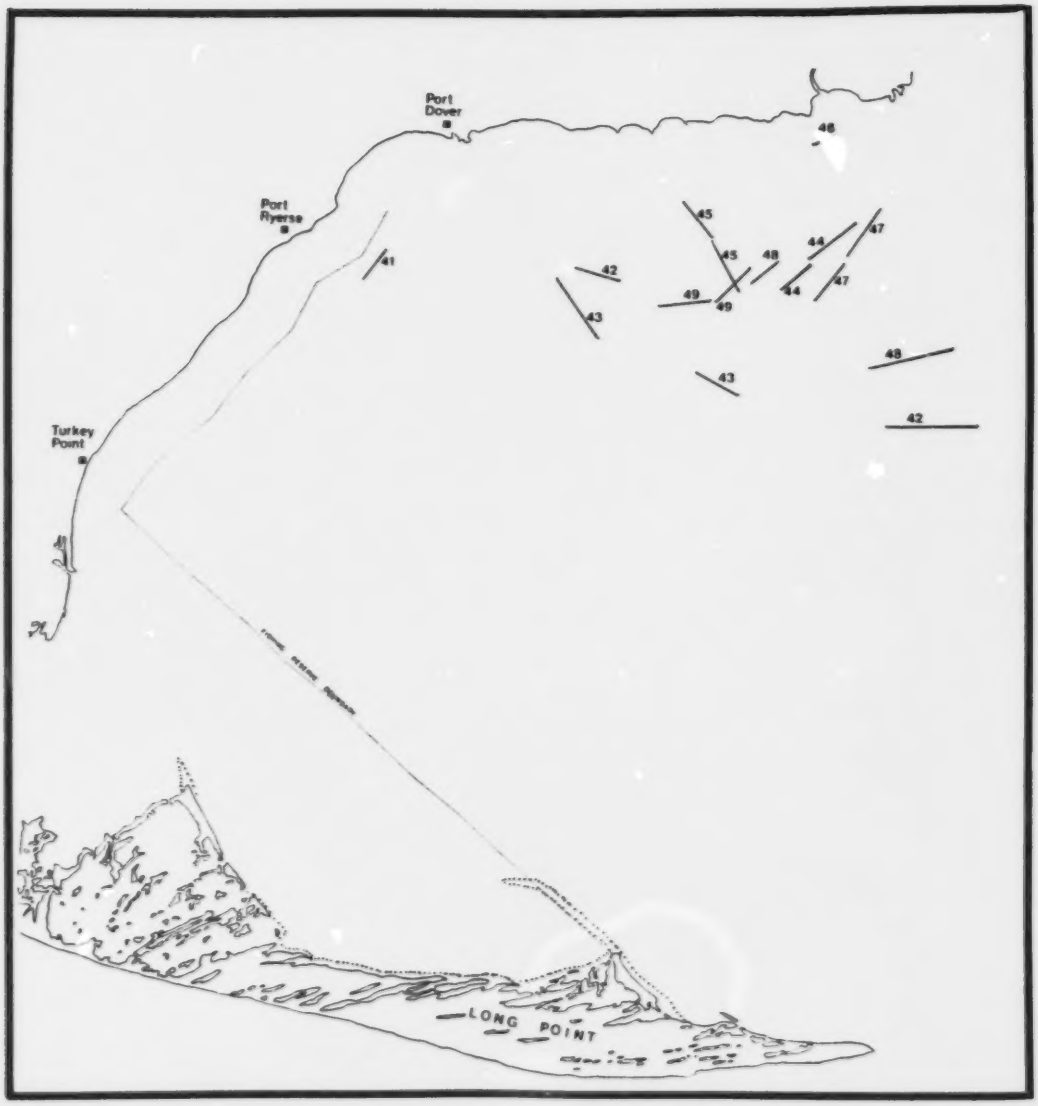
Appendix Figure V. Locations of commercial gillnet straps examined by OMNR staff between July 27 and July 31 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.



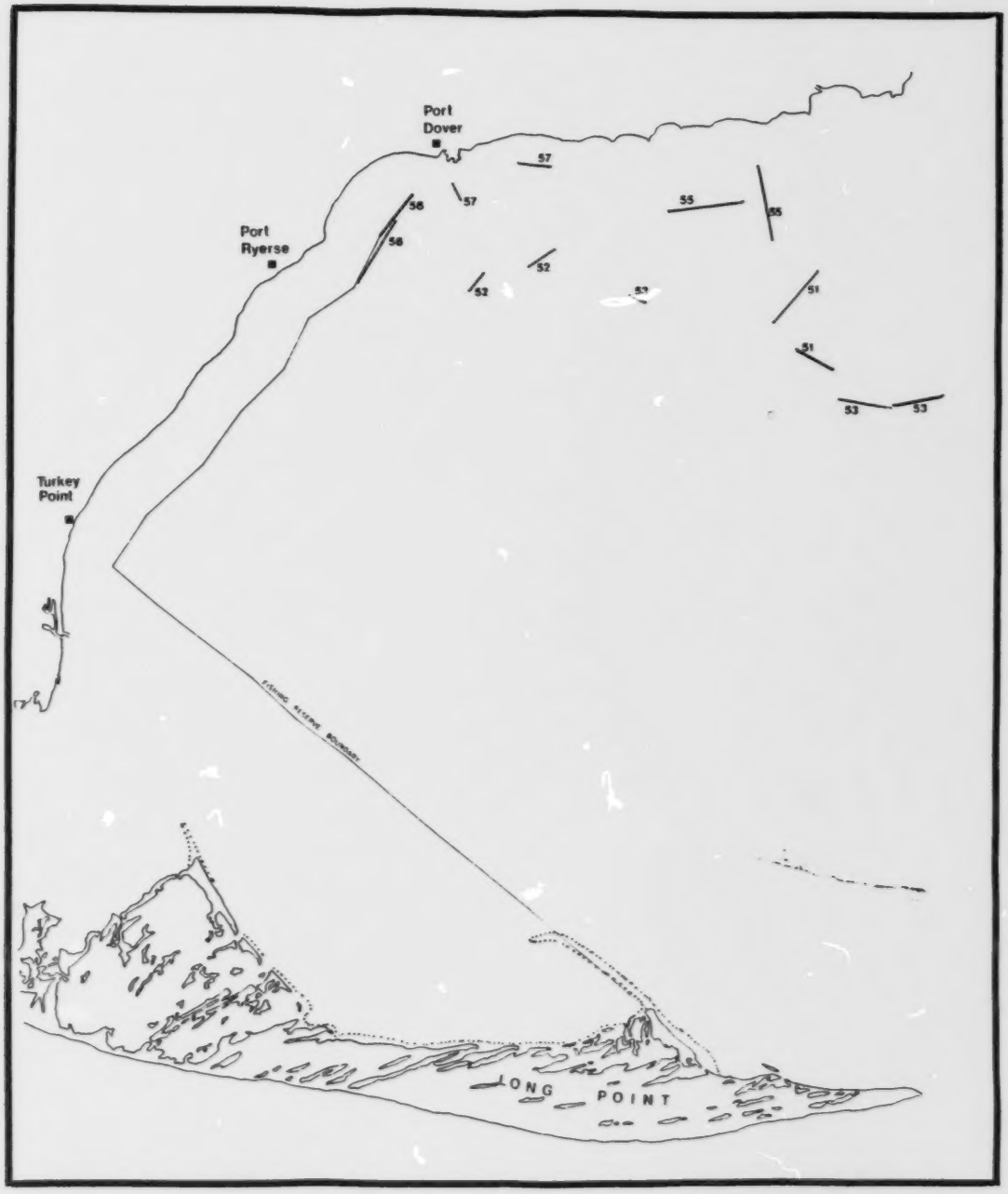
Appendix Figure VI. Locations of commercial gillnet straps examined by OMNR staff between August 4 and August 7 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3. Single points denote location(s) of strap(s) where LORAN-C was not functioning.



Appendix Figure VII. Locations of commercial gillnet straps examined by OMNR staff between August 10 and August 21 during the on-board survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.



Appendix Figure VIII. Locations of commercial gillnet straps examined by OMNR staff between August 26 and September 11 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.



Appendix Figure IX. Locations of commercial gillnet straps examined by OMNR staff between September 15 and September 24 during the On-Board Survey. Numbers beside each strap refer to Fisherman No. in Tables 2 and 3.

Appendix Figure X.

ATTENTION ANGLERS!

INNER BAY FISH SANCTUARY

A Fish Sanctuary has been established by Regulation on part of Inner Long Point Bay. It is now necessary to refrain from all fishing between May 15 to the last Saturday in June each year — in the area labelled NO FISHING AREA below.

The Sanctuary is to protect the bass fishery during the spawning period.

The number of anglers fishing in Inner Long Point Bay during late May and June is increasing — resulting in increased stress on the bass.

Even an accidentally hooked (and returned) bass guarding its nest can mean the loss of its reproduction effort for the year . . . and that means fewer bass in the years to come.

Your cooperation will help the bass — and protect your sport!

Ontario

Ministry of Natural Resources

Hon. Vincent G. Kerrio
Minister

Mary Mogford
Deputy Minister

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